

## **Historic, Archive Document**

Do not assume content reflects current scientific knowledge, policies, or practices.



9281.9  
987  
of 2

A Summary of Current Program, 10/1/66  
and Preliminary Report of Progress  
for 9/1/65 to 10/1/66

\*-\*

FARM PRODUCTION ECONOMICS DIVISION  
of the  
ECONOMIC RESEARCH SERVICE  
UNITED STATES DEPARTMENT OF AGRICULTURE  
and related work of the  
STATE AGRICULTURAL EXPERIMENT STATIONS

U. S. DEPT. OF AGRICULTURE  
NATIONAL AGRICULTURAL LIBRARY

APR 17 1967

CURRENT SERIAL RECORDS

This progress report is primarily a tool for use of scientists and administrators in program coordination, development and evaluation; and for use of advisory committees in program review and development of recommendations for future research programs.

The summaries of progress on USDA and cooperative research include some tentative results that have not been tested sufficiently to justify general release. Such findings, when adequately confirmed, will be released promptly through established channels. Because of this, the report is not intended for publication and should not be referred to in literature citations. Copies are distributed only to members of Department staff, advisory committee members and others having a special interest in the development of public agricultural research programs.

This report also includes a list of publications reporting results of USDA and cooperative research issued between September 1, 1965, and October 1, 1966. Current agricultural research findings are also published in the ERS publications The Farm Index, a monthly, and Agricultural Economics Research, a quarterly. This progress report was compiled in the Farm Production Economics Division, Economic Research Service, U. S. Department of Agriculture, Washington, D. C. 20250.

UNITED STATES DEPARTMENT OF AGRICULTURE  
Washington, D. C.  
October 1, 1966



# TABLE OF CONTENTS

	Page
Introduction-----	iii
Area No. 1    Agricultural Adjustments, Production Response and Farm Program Appraisal-----	1
Area No. 2    Economics of Farm Management and Conservation Practices-----	22
Area No. 3    Structure of Agriculture and Economics of Farm Size-----	30
Area No. 4    Farm Capital, Credit, and Financial Condition-----	35
Area No. 5    Agricultural Risks and Insurance-----	44
Area No. 6    Farmland Values and Valuation-----	49
Area No. 7    Economics of Farm Practices and Technology--	55
Area No. 8    Farm Costs and Returns-----	63
Area No. 9    Farm Labor Utilization and Productivity-----	68
Line Project Check List-----	75



## INTRODUCTION

Farm production economics research, as used in this report, deals with many and varied economic problems of agricultural production. The work is concerned with the economics of organization and management of farms, use of capital and labor in agriculture, production and conservation practices, adjustments in production and resource use, farm financial problems of credit and insurance, and appraisal of alternative production policies and programs.

A continuing major problem in agriculture is the adjustment of production, both in the aggregate and for major commodities, to market outlets. Achievement of economic balance in agriculture and adequate returns to farmers is likely to continue to be difficult over the next 5 to 10 years as we strive to match the increasing capacity of agriculture to produce with the food and fiber requirements of a larger U. S. population and expanding outlets for exports and Food for Peace programs. Farms are decreasing in number and increasing in size and degree of specialization. Farm machinery, fertilizers, and other innovations, are substituting for land and labor. Coupled with rising farmland values, these developments necessitate large and increasing capital investments per farm, and alter farm credit and insurance needs. Increasing dependence on purchased inputs and on cash markets for products make net income increasingly vulnerable to changes in prices of both inputs and outputs. These trends challenge the most rigorous research in the field of farm economics. Results of research in this field are widely used as aids in management and policy decisions at the farm, area, regional, State, and national levels.

The Department's program of research and related statistical reporting in farm production economics is conducted from headquarters in Washington, D. C., and is concerned chiefly with problems of regional and national scope. Field studies generally are conducted in cooperation with State experiment stations. When studies are made jointly by Federal and State workers, Federal people usually are most interested in regional and national applications of results, while State workers are most often interested in local applications. Close working relationships between Federal and State agencies have long been traditional in this field. This close cooperation in planning and conducting the work reflects joint and cooperative efforts rather than overlapping or duplication of effort.

The farm production economics research program is covered under 9 area headings shown in the Table of Contents. More detailed subject-matter subheadings are given in the discussion of each area of work.

During the year covered by this report, the special policy and program contributions that the Division has been able to make have been significant. Division personnel have responded to many requests for assistance from the



Office of the Secretary, program administrators, Members of Congress, and others. In addition, many of the Division's continuing statistical series and analyses have become increasingly important in efforts to understand changes and achieve improvements in the structure and in the well being of American agriculture.

Some illustrative examples of Division research contributions during the reporting period follow.

Costs of Producing Upland Cotton Measured. An enumerative survey of about 5,200 cotton farms was conducted in February and March 1965 to obtain basic data on costs of producing the 1964 cotton crop. This survey was conducted to aid in guiding the Department's special research programs for reducing the costs of producing Upland cotton, and to furnish data to fulfill the provision in the Agricultural Act of 1964 that the Secretary consider, among other factors, the cost of producing cotton in establishing price support levels. The survey was conducted in 18 major cotton production regions and provides production cost and input data for these regions as well as for 3 selected size-of-farm groups in each region. The cost summaries show the composition and variability of costs within and among regions, and the proportion of total production that is produced below specified levels of cost. Allowing market rates of return to all inputs used, the total cost of producing the U. S. crop of Upland cotton in 1964 was 28.4 cents per pound of lint. When costs of land and items of farm overhead are excluded, total direct cost was 21.6 cents per pound. About 64 percent of the 1964 crop was produced at a total cost of less than 30 cents per pound, and about 88 percent at a direct cost of less than 30 cents. Estimates of total cost per pound of lint varied from an average of 23.4 cents in the Mississippi Delta Region to an average of 38.1 cents in the Upper Rio Grande-Trans Pecos Region of Texas and New Mexico. Direct costs per pound in these two regions averaged 17.9 cents and 29.5 cents, respectively. When unpaid family labor and owned production assets were valued at market rates, large farms had distinctly lower costs per pound of lint than small farms. The difference between the largest and smallest size group was typically 8 to 10 cents per pound.

Any attempt to reduce costs of producing cotton should emphasize the reduction of labor, power and equipment costs, which comprise a substantial proportion of total costs in all regions. Labor costs averaged, nationally, about \$38 per bale, and ranged from an average of \$22 per bale in Southern California and Southwest Arizona to \$52 per bale in the Southern Piedmont Region. Power and equipment costs averaged about \$30 per bale for the United States and ranked second to labor in most regions. Subsequent cost surveys are planned to measure both the changes in production costs due to changing production methods and the year-to-year variability in production costs due to weather factors.



Cropland Conversion Program Studied. The 1964-65 Cropland Conversion Program was a pilot program in 100 counties that offered farmers payments for converting land from row crops and small grains to conserving uses under 5- to 10-year contracts. Nearly all land in the program was converted to pasture. A study of 446 farms in the program in 12 areas showed no significant differences between CCP farms and other commercial farms in such factors as acres in farm, percent of land used for crops, or the proportion of cropland accounted for by base or allotment crops. Crop yields on CCP farms tended to be slightly above the average of all farms. However, variability was evident in the appraisal of land quality by different ASC Committees. Farms in the program had more than the average number of cattle per acre, and most CCP participants were planning further increases in cattle numbers. Although payments for participating in programs other than CCP were reduced when land was placed under CCP agreements, total program payments increased in 10 of the 12 areas studied. Many farmers, however, invested all of their payments and more in soil improvement, livestock, fences, and other farm improvements. Output reduction for each farm as a whole ranged from \$0.67 to \$3.87 per dollar of program costs. Payment rates were tied to productivity, but there was no significant relation between per-acre payment and output reduction per dollar of program costs. More than 3/4 of the farmers intended to leave their CCP land in grass after the agreements expired, and they expected that their incomes would be higher in 1970 and later years than they would have been if they had not participated in the program.

Farmers Use of Chemical Pesticides Estimated. Preliminary estimates from the Nationwide Pesticide Survey conducted in early 1965 show that in 1964, 94 percent of all farmers surveyed used chemicals for controlling pests of crops and livestock. The survey included a sample of farms with sales of agricultural products of \$5,000 or more in all areas of the United States except the South. In the South -- Appalachia, Southeast, and Delta States -- farms with sales of over \$2,500 were included. Nearly 3/4 of the farmers interviewed used pesticides on crops. The highest proportion of farmers using pesticides was in the Appalachian States where many farmers raise tobacco or cotton. Ninety-five percent or more of the tobacco, vegetable, and fruit and nut farms used pesticides on crops. In the Mountain States and the Southern Plains only about half of the farmers treated crops because of the large amount of pasture and grain crops grown. About 90 percent of the dairy farms and 75 percent of the livestock farms treated livestock with chemical pesticides. Many other farms had only small livestock enterprises, if any. These preliminary estimates and other data indicate that total expenditures for the United States in 1964 were between \$480 and \$500 million, including about \$50 million used on smaller farms not included in the survey. Of the total expenditures, about 85 percent was for the treatment of crop pests, growth regulators, and harvesting aids. These preliminary estimates do not include expenditures for seed treatment or treating stored crops and storage buildings.

Supply-Price Relationships of U. S. Cotton Analyzed. The Farm Production Economics Division, the Cooperative State Research Service, and the Agricultural Experiment Stations in the major cotton-producing areas of the U. S. cooperated in a regional research project to determine the supply-price relationship of cotton assuming no allotment requirements for cotton or competing crops including rice, tobacco, peanuts, and wheat. It was assumed that the individual farm operator would make the adjustments that appeared to be the most profitable from his standpoint. Enterprise input-output coefficients are based on what is now visualized as the highest level of proven technology with proven production practices; i.e., an advanced level of technology is assumed. The price of cotton was varied from 15 to 35¢ per pound, while the prices of the factors and other products were held constant at assumed equilibrium prices. Data pertaining to crop acreage and production were developed for 17 geographic areas which accounted for 81 percent of the cotton produced in the United States in 1962. The output response at the various prices were as follows: 15¢ per lb., 1.9 million bales; 20¢, 12.0 million; 21¢, 18.6 million; 22¢, 21.7 million; 23¢, 24.0 million; 24¢, 29.1 million; 25¢, 31.9 million; 30¢, 37.8 million; and 35¢, 38.5 million bales. Little cotton would be produced at a price less than 15¢ per lb. The relatively larger increase in production between 15 and 25¢ prices is indicative of the profitability of cotton relative to other crops. When the price of cotton is increased from 25 to 30 cents per pound, cotton replaces soybeans and wheat, since it becomes more profitable than these crops. At a price of 30 cents per pound for cotton, essentially all of the land so adapted is in cotton. Consequently, there is little change in the output between 30 and 35 cents per pound.

Estimates were also made for domestic consumption and foreign production and consumption for 1975. This analysis indicates that the total off-take of cotton produced in the United States would range from 4.7 million bales at 35 cents per pound (U. S. Farm Price) to 23.3 million bales with 15-cent cotton. The export demand for U. S. cotton is more elastic than the domestic mill demand. A comparison of the estimated supply-response of cotton and the off-take of cotton produced in the U. S. indicates an equilibrium price of about 21 cents per pound. At this price the equilibrium quantity would be about 16.4 million bales of which 10.6 million bales would be used by domestic mills and 5.8 million bales would be exported.

Below are some illustrative examples of research reported by State Experiment Stations.

Decline in Louisiana Vegetable Production Studied. The Louisiana Station found that the general decline in vegetable production in the State could be attributed largely to the changes in tenure, increase in off-farm employment opportunities, and marketing problems. In past years vegetable crops were produced during relatively "idle" seasons of the year providing employment



for resident sharecroppers. The producers interviewed indicated that marketing was their greatest problem. Precisely what this meant was not clear. Research to determine the marketing problems, including their causes and effects, is needed. Another area indicated as needing study is the alternative opportunities available for employment of resources in other farm enterprises.

Time Spent on Managerial Activities in Dairy Farming Analyzed. There has been a substantial increase in the size of dairy farms in the Northeast since World War II. This growth in farm size is expected to continue. Several studies have shown changes in input, output, efficiency, and income as farms grow in size, but little work has been conducted showing the changing demands for management as farms become larger. The Cornell Station has conducted such a study. Activities were divided into the following categories: (1) nonfarm, (2) farm-related, (3) regular labor, and (4) managerial. Managerial activities consist of record keeping, information gathering, buying and selling, labor supervision, analysis of data, and decision-making. Time spent on such activities increased from an average of 610 hours per year on farms with 40 to 74 cows to an average of 1,310 on farms with 125 to 340 cows. This amounted to 19 percent and 42 percent, respectively, of farm operators' total available time. The extra time required for managerial activities on larger farms reached the available time for the operator to function as a laborer. Profits in farming depend upon an optimum size operation. Hence, as farms become larger, success will depend more on the degree to which the operator functions as a manager and less on how hard he works as a laborer.

Optimum Ration for Dairy Cattle Determined. The Iowa Station found substitution of grain and forage to be at diminishing marginal rates. Consequently, the optimum ration varies with the prices of the two types of feed. Similarly, since the isoclines derived are not linear through the origin of the feed plane, the optimum ration also changes as the price of milk increases or decreases and as feed prices are constant relative to each other. Selected cow characteristics also are predicted to substitute for feed and for each other at diminishing marginal rates in attaining a given level of milk production. Although the step is not taken in this study, these measurements allow quantification of the relative economic importance of increasing the milk output per cow through improved breeding, alternative rations, and other adjustments.

As a step toward implementation of the recommendations for a National Program of Research for Agriculture made jointly by the Association of State Universities and Land Grant Colleges and the USDA, a section has been added to each of the Areas in this report. It comprises a list of the related publications of the State Agricultural Experiment Stations in addition to those heretofore reported covering the results of USDA and cooperative research. In future years, it is anticipated that information will be available to permit reporting of achievements resulting from State research in a format comparable to the present reporting of the USDA and cooperative research.



AREA NO. 1. AGRICULTURAL ADJUSTMENTS, PRODUCTION  
RESPONSE AND FARM PROGRAM APPRAISAL

Problem. A chronic major problem in agriculture is to adjust production, both in the aggregate and for major commodities, to market outlets. Achievement of economic balance in agriculture and adequate returns to farmers is likely to continue to be difficult over the next 5 to 10 years as we strive to match the increasing capacity of agriculture to produce with the food and fiber requirements of a larger U. S. population and expanding outlets for exports and Food for Peace programs. Some resources now used in lines of production that are either overexpanded or in short supply need to be shifted. Individual farmers can reduce costs per unit of product by reorganizing farm enterprises, adopting improved technology, and increasing the size of their farms. But when many farmers do this, total output mounts and the problem of bringing total supply in line with total demand is intensified. Thus adjustment opportunities cannot be considered solely from the viewpoint of the individual farmer. National and regional aggregate production response are important in considering the farm adjustment problem. Analyses of profitable adjustments on representative farms and estimates of both the aggregate output that would be forthcoming if all farms were efficiently organized and operated, and the aggregate response that farmers would be expected to make, are needed as a basis for evaluating the adjustments that would be profitable both to individual farmers and to the industry under different economic situations, and for appraising the effects of alternative farm adjustment programs. Continuing analysis of trends in farm output and resource productivity is also needed to measure changes in the farm situation.

USDA AND COOPERATIVE PROGRAM

The program encompasses 4 major types of work. Studies of national and regional productivity conducted in Washington, D. C. analyze the factors responsible for changes in total output and resource productivity for the Nation and for 10 broad farm production regions. These studies become the basis for long-term projections of prospective trends in farm output and productivity, in numbers of farms, and in other major characteristics of the Nation's agriculture. Studies of production response and needs for adjustment are conducted in Washington, D. C. and at several field locations. These studies emphasize the methodological developments required to appraise the production response farmers are likely to make individually and in the aggregate to changes in technology, prices, programs, and other factors. Attention is also given to the optimum (least cost) regional distribution of crop and livestock production. Area adjustment studies in dairy, cotton, wheat, rice and feed-livestock areas emphasize the determination of the most profitable adjustments for representative farms to alternative combinations of prices. The most profitable organizations, weighted by the proportion of the total number of farms represented by each typical farm, provide first approximations of the area implications of individual farm adjustments.

These studies are conducted in cooperation with 15 State Experiment Stations in dairy areas, 16 in cotton areas, 11 in wheat areas, and 18 in feed-livestock areas. Studies of adjustment opportunities in rice areas are conducted in Arkansas, Louisiana, Mississippi, and Texas. Studies of agricultural policies and program appraisals are oriented toward an understanding of the impacts and means of improving programs and policies at the national level, including the acreage allotment programs, wheat programs, the probable effects of alternative sugar quota and pricing policies, prospective use of land released from the Conservation Reserve, and impacts of the current feed grain program.

A total of 55.7 Federal scientist man-years are devoted to this area of work: 2.0 man-years to national and regional productivity in agriculture; 20.2 man-years to appraisal of production response and needs for adjustment including 0.3 on a research contract with the University of Wisconsin to develop an improved model for explaining aggregate production response; 3.5 man-years to appraisal of adjustments in dairy areas; 6.3 man-years to adjustments in cotton areas; 6.1 man-years to adjustments in wheat areas; 4.2 man-years to adjustments in rice areas; 8.7 man-years to adjustments in feed-livestock areas; 1.0 man-year to appraisals of agricultural policies and programs; and 3.7 man-years to cotton cost analysis.

#### PROGRAM OF STATE EXPERIMENT STATIONS

A total of 54.8 scientist man-years is devoted to this area of research.

#### PROGRESS -- USDA AND COOPERATIVE PROGRAM

##### A. National and Regional Productivity in Agriculture

Preliminary estimates of total farm output in 1966 indicate a 2-percent decrease from the 1965 level but an outturn the second highest of record. Total livestock production is estimated to increase about 1 percent. Production of dairy products will decline but will be offset by increases in production of meat animals and poultry products. Production of poultry products will set a new high. Total crop production in 1966 is 5 percent below the 1965 record. Feed grain production is down 2 percent, although production of sorghum grain is at a record level and corn production the third highest of record. Food grains are 1 percent below last year. A record soybean production--10 percent larger than last year's high--led to an increase in production of oil crops of 6 percent. Cotton production is 27 percent below last year, chiefly because of a reduction of 25 percent in acreage planted.

Total inputs used in agriculture in 1966 are estimated to be 4 percent above the 1957-59 average and 1 percent above 1965. Farmers continued to increase their purchases of nonfarm inputs. The volume of fertilizer and liming materials purchased in 1966 increased 3 percent from 1965, and were nearly 45 percent greater than 5 years earlier. Purchases of feed, seed, and livestock increased 5 percent over 1965. Purchases of chemicals for controlling



weeds and insects continued the rapid increase of recent years. Inputs of farm real estate have remained about constant for more than a decade. Labor inputs have continued to decline, largely offsetting the increase in use of nonfarm inputs. Farm labor inputs in 1966 were 4 percent below the 1965 level.

In a reappraisal of prospective increases in crop yields it was concluded that average yields of corn may equal 85 bushels by 1970, cotton yields may rise to 620 pounds of lint, and rice yields climb to 4,880 pounds per acre. These yield increases are expected as farmers increase their use of improved seeds, fertilizer, and other improved practices.

Data assembled by the U. S. Weather Bureau in their recently developed drought indexes are being used in studies of weather-technology effects on crop yields. Measures of supply and demand of moisture, calculated for most areas of the United States, are available for use in our research. An exploratory analysis of annual variations in Kansas wheat yields for the period 1954-65 has been made. Changes in weather, fertilizer use per acre, and acres harvested explained 80 percent of the annual yield variations. The weather variable was the combined difference between the supply and demand of moisture for the months of September, October, May and June.

A study of productive capacity and aggregate resource adjustments in U. S. agriculture, being conducted jointly with the Oklahoma Experiment Station, has resulted in the development of a number of simulation models. Illustrative of the general results of these simulations are (1) the elimination of production controls and Government payments tended to depress farm incomes, (2) supports higher than current levels resulted in improved farm incomes, (3) supports lower than current levels tended to depress product prices and farm incomes, (4) high national employment and high levels of disposable income resulted in improvement in the farm segment of the economy, and (5) a high rate of adoption of technology tended to increase output which resulted in lower product prices and lower farm incomes.

#### B. Appraisal of Production Response and Needs for Adjustment

Progress was made in the development and testing of a "national model" for production adjustment research and policy guidance. A 5-year test (1960-64) of the model's ability to predict changes in acreage and production one year ahead was completed for all but a few of the 90 farming situations in the model. Results for cotton, wheat, feed grains, and other commodities indicate that with various improvements in methodology and data, and with the intended annual updating of all data, the model should provide relevant estimates of farmers' aggregate response to changes in prices, technology, resource availability, and Government programs. Among the most common sources of predictive error in the "1-year" test results are (1) the relatively small number of resource situations, hence errors of aggregating farms; (2) the aggregation of inputs of varying productivity into a single input, such as use of only one soil type, and in some areas, input aggregation over time (for example, an annual supply of irrigation water instead

of time-period supplies); (3) the problem of quantifying many "restrictions"; (4) over- or underestimation of farmers' expectations of prices and yields; and (5) inconsistencies between input requirements per acre or per animal used in the model and data on actual input quantities used or produced. Further evaluation and preparation of a preliminary progress report will await completion of the more critical test of the model's ability to predict response 2 to 5 years ahead.

A study initiated last year has resulted in a proposed procedure for grouping farms in a way that minimizes aggregation error in formal analyses of aggregate production response. The procedure permits estimation of the relationship between the number of representative farms or groups of farms delineated and the potential error from averaging or grouping farms that do not respond alike. Refinements are being made and data are being assimilated for testing the grouping procedure in a selected farming region.

Progress was made on a related cooperative study with the Iowa Experiment Station designed to measure error in estimating aggregate supply functions from linear programming solutions of representative farms. The objective of the research is to measure error from 3 sources: The number of representative farms used, the method of their stratification, and the specification of the relevant alternatives and resources available to them.

The first step in the study was to stratify survey data on Iowa farm resources into 4 sets of representative farms. The second step was to develop 4 sets of supply functions by linear programming each representative farm in each set. Lastly, these results were aggregated within each set. The differences among the 4 sets of supply functions are due to aggregation error, and the analysis shows how this error is affected by the number of representative farms programmed and by the method of stratification.

The 4 sets of representative farms were: (1) 36 farms which constituted 3 or 4 different sizes in each of 10 different soil type areas of the State, (2) 10 farms which were the average farms in each of the 10 soil areas, (3) 3 farms which represented the small, medium, and large farms in the State, and (4) 1 farm which was the State average farm. Comparisons, using the 36 farm supply functions as a base, reveal 2 general characteristics of the aggregation error. First, there is no significant direction to the error that arises as smaller numbers of representative farms are employed to estimate State supply functions. Second, the error that arises from using smaller numbers of representative farms is generally not large; in fact, it may appear relatively minor when compared to probable specification and sampling errors. The programming results in Iowa suggest that many of the observed differences in enterprises on actual farms do not arise from differences in resources, but rather to factors such as (1) differences in management ability of operators, (2) variation in farmer preferences for different enterprises, and (3) degree of subjective discounting for uncertainty. Farms should be stratified by such factors if it is desired to minimize aggregation error in predictive models.

A start was made on another cooperative project with the Iowa Station in which the objective is to develop a regional model that will permit intra- and inter-farm adjustments in resource use, and is subject to regional supply constraints on resources.

A cooperative project with the Purdue Station also is designed to develop a regional supply model which permits inter- and intra-farm adjustments of resources, and is also subject to flexibility constraints that simulate the behavior of representative firms through time. Production functions were estimated for 8 areas of Indiana, 4 types of farms in each area, and aggregated functions for all farms and types of the State. From the estimated production functions, it was possible to test at what level the types of farms and areas could be aggregated on the basis of no significant difference in their production functions. In one area tested the type of farm functions were not significantly different than the area function.

Cooperative research with Iowa continued on studies of interregional competition in U. S. crop and livestock production. As part of the overall study, work has started on developing a quadratic programming routine to be used to solve an interregional programming problem employing a quadratic objective function. Thus far the routine has been developed but no solutions have been obtained. The current model includes 25 production regions and 9 consumption regions for wheat, corn, oats, barley, feed grains, and oil meals. Refinements to be made in previous work on a large-scale interregional model include (1) designation of farm size groups in each producing region, (2) inclusion of labor and capital as well as land resource constraints, (3) consideration of 3 land quality classes in each producing region, and (4) several refinements in the transportation activities. Progress has been made in the development of the necessary technical coefficients.

#### C. Appraisal of Adjustments in Dairy Areas

Milk supply response functions were estimated for 20 areas in the Northeast for 1960, 1965, and 1970. They represent the production that would be profitable on representative farms, assuming the level of management used by the upper 25 percent of the farmers in 1961. Work was started on an equilibrium analysis of demand and supply of milk in the 20 areas. Supply estimates developed through the linear programming analysis of benchmark farms were used along with demand projections to estimate free market production, distribution, and consumption of milk. Estimates developed so far used the 1960 resource base. Further work will include the 1965 and 1970 resource bases. Supply and demand basing points used in this equilibrium model were determined by a "Center of Moments" procedure, and transportation costs between these points were calculated. These transportation costs, the area milk supply functions, and a set of area milk demand functions form the input data for the spatial equilibrium analysis of milk.

In a continuing effort to develop a more predictive procedure for describing the economic response of farmers, several analytical models have been developed. A new type of area aggregation model is being tested. This model



focuses on both the feasible on-farm alternatives and the feasible area alternatives. This approach will lessen the tendency to exaggerate the milk supply and also allow more specific handling of changes in the resource base through time. One of the features of this particular model is that it allows transfer of some resources between farms. For example, this model would allow for the transfer of land or for the transfer of labor between farms in a particular area. Another approach to making a more predictive estimation of supply response focuses on comparing 3 methods of estimating supply. One procedure uses a regression-type model with parameters estimated from milk price and output time-series data published by the Crop Reporting Service. A second procedure uses a linear programming model in which Markov Chain techniques are used to estimate changes over time in the so-called "fixed factors" of land, family labor, and barn space. The third method uses a linear programming model in which, over time, these fixed factors are adjusted endogenously by the use of expansion and contraction vectors. These procedures will be used to estimate milk output in one of the study areas in the Northeast for the years between 1960 and 1965. The 3 models will be evaluated by comparing their estimates of output at "expected" current prices with the actual output for those years. A third approach to enhancing the predictive possibilities associated with supply response work involves cooperation in a producer panel study, which has been in existence since 1960. Its purpose is to gather data on changes in the number of farms, their size and organization, and the production of milk. The producer panel data were used this year to make an assessment of recent changes and projected costs of the dairy industry in the greater New York-New Jersey market.

In the Lake States, a report has been completed on the use of a producer panel to estimate changes in agricultural production on Minnesota's dairy farms from 1959 to 1963. Most of the producers in the panel made only minor changes in the number of cows during the period.

In Michigan, a comparison of data from surveys taken in 1959 and 1963 indicates a trend from full-time dairy operations to part-time cash grain operations. Opportunities for off-farm employment are strong in Michigan. Fifty-five percent of Michigan farmers hold off-farm jobs, mostly full-time jobs. Many part-time farmers also put land into Government diversion programs. The results are reported in a cooperative Michigan Station publication, "Part-time Farming in Two Areas of Southern Michigan, 1959 and 1963: Changes and Similarities."

An analysis of alternative systems of forage harvesting and feeding for Wisconsin dairy farms with 120 acres or less hay land indicates that baling with a bale thrower and hand feeding is the least-cost method. Low moisture silage methods cost \$3.10 more per ton at these acreages. However, low moisture silage methods have the advantage of lower risk in harvesting. With larger acreages and with higher priced labor, this method would reduce costs. The results are being prepared for publication.

#### D. Appraisal of Adjustments in Cotton Areas

During the year emphasis in cotton adjustment work has been directed toward the development of optimum organizations for representative farms and associated aggregates of production, labor, annual operating capital, and returns under alternative allotment level-product price combinations for all major cotton-producing areas of the South and Southwest. In addition, the effects of changes in factor prices on minimum land requirements to meet specified levels of income were studied in the South. Optimum farm organizations for representative farms under 12 cotton allotment and price situations were computed for all major production areas. Based on these optimum organizations, aggregate estimates of land use, production, labor used, capital requirements, and net returns were made for each area for each of the price-allotment situations. The estimates are being combined for a beltwide analysis of the aggregative effects of various alternatives.

Progress has been made in the analysis of adjustment opportunities in the peanut and burley and flue-cured tobacco areas where cotton is not a major crop. Emphasis in the peanut and tobacco studies has been in computing optimum organizations of representative farms for various peanut or tobacco acreage allotment situations and expanding these organizations into area aggregates.

A study for refinement of technical coefficients for use in programming optimum organizations in the Delta of Louisiana is now in its third year. Detailed information is being collected on the soil-technology-rainfall-output complex. It is expected that the refined coefficients will permit a better analysis of the economic relationships among available production alternatives. It was anticipated that, primarily because of weather variations, 3 to 5 years would be needed to complete the study. The data collecting phase has progressed satisfactorily.

The distribution of burley tobacco allotments has not changed for about 30 years and as a result production has not moved to areas in which the crop might have a competitive advantage due to structural changes in factor markets or production technology. A study is underway to determine the changes that would take place in the locational pattern of production if Government control programs were changed to allow allotments to move freely by lease or sale. The geographical areas of analysis have been delineated, the data needed have been decided upon, the methods and procedures have been devised, and a partial development of the programming model has been developed. The acreages and percentages of land in each capability class have been computed for the entire study area. Historical trends of the yields for the major enterprises in the study area have been compiled and are being used in developing the enterprise budgets.

#### E. Appraisal of Adjustments in Wheat Areas

Work progressed on studies of adjustments in wheat areas in the Plains and the Pacific Northwest. The studies are in cooperation with Regional Research

Projects W-54 and GP-5. Work proceeded on delineation of adjustment study areas, selection of representative farms, development of enterprise input-output relationships, and estimation of optimum systems of farming by linear programming procedures.

In Colorado, budgets projected to 1970 for alternative crop and livestock enterprises, as well as programming matrices, have been developed for each of the 5 wheat adjustment areas. Because preliminary programming results indicated that size of farm is not a major variable in influencing differences in farm organization, a composite farm of medium size, with different levels of soil productivity divided on the basis of area totals, was used as the representative farm situation in each of the 5 areas. A procedure for projecting yields to 1970 that was developed in collaboration with an agronomist at the Colorado Experiment Station has been submitted to the Journal of Agronomy for publication. Crop enterprise costs and returns in 1965 were developed and published.

In Kansas, much of the programming has been completed for northwestern Kansas and it is underway for southwestern Kansas. Crop and livestock enterprise budgets have been developed for dryland farms in east central Kansas. Work on crop enterprise budgets for partly irrigated farms in western Kansas is underway. Preliminary programming indicated that size of farm is not an adequate basis for classification of farms. Proposals for revising and amending the GP-5 procedures for preparation of enterprise budget forms were developed and cleared with the Technology Subcommittee of GP-5.

In Nebraska, 6 adjustment areas were delineated in the Nebraska Panhandle, southwestern Nebraska, and south central Nebraska. Representative dryland wheat farms were defined for each of the 6 areas. Available data indicate that wheat is a negligible enterprise on irrigated farms and livestock ranches. In each area, 3 farm size groups have been specified. Alternative crop and livestock enterprise budgets are being prepared.

In a study of wheat supply response in north central Oklahoma, a complete physical resource inventory for the area was compiled. Enterprise budgets for this study area are included in a manuscript "Alternative Crop Enterprises on Clay and Loam Soils of North Central Oklahoma; Resource Requirements, Costs and Return" which has been submitted for publication. A similar manuscript for northwestern Oklahoma is in process.

In Texas, a study of wheat supply response is being conducted in the major wheat-producing areas. Linear programming models developed for Regional Research Project S-42 for the High Plains and the Rolling Plains will be utilized in the wheat supply study. The results will be aggregated for Regional Research Project GP-5.

In Montana, the manuscript "Projection of Farm Numbers in Montana to 1975 and 2000" has been cleared for publication by the Montana Experiment Station as a cooperative bulletin. All input-output coefficients for alternative crop and livestock enterprises have been completed. Also, resource restric-



tions for representative farm situations have been specified. Preliminary programming has been done to test the model.

In North Dakota, a manuscript "Grass Seeding on Cropland in Southwestern North Dakota" is being reviewed for publication as a cooperative Experiment Station-ERS bulletin. A comparison of the variability of net income on cash grain farms which include regrassing and livestock indicates that incomes can be increased and stabilized so long as reseeding does not reduce wheat acreage below the 1965 level. Even at relatively low wheat prices (\$0.95 per bushel) farm income is reduced if any of the 1965 wheat acreage is replaced by regrassing and livestock enterprises. All enterprise coefficients, resource restrictions for representative farm situations, and linear programming matrices for the southwest, northwest, and north central North Dakota adjustment areas have been prepared.

In South Dakota, input-output data were completed for alternative crop and livestock activities. Programming matrices, now being constructed, are nearly complete for all South Dakota GP-5 adjustment areas.

In Washington, a study of the production of green peas in southeastern Washington and northeastern Oregon gives particular attention to the economics of a new harvesting technique. Self-propelled combines are rapidly replacing the traditional viner station of pea separation in the region with the effect that labor needs are greatly reduced. Ownership of combines by processors is upsetting the historical bargaining structure of the industry by eliminating or transferring to processors certain tasks previously performed by producers. Acreages, farm numbers, and cropping budgets are available now for 10 of 11 designated regions in the State.

In Idaho, progress was limited to projection of wheat yields because personnel was assigned to the project late in the year. Preliminary regression analysis indicates that about 60 percent of the variation in wheat yields was accounted for by the amount of precipitation during the April through June period. Production function analysis indicated that when the planted area of dryland wheat in Idaho was increased from 500,000 to 800,000 acres, marginal physical product declined from 27 to 6 bushels per acre. It appears that dryland wheat production in southeastern Idaho cannot be expanded economically beyond the 900,000-acre level without a major shift in the level of applied technology. Preliminary results also indicate that the use of new crop varieties, fertilizers, and pesticides have had little effect on crop yields in the area since 1946. More conclusive results will become available as the analysis progresses.

In Oregon, work is underway on the aggregate response of wheat producers to various prices and technology. The study includes an analysis of causes for differences between actual performance and projected performance on 20 farms for the period 1963-65. Projected performance was estimated by constructing approximately 100 separate budgets for enterprises. A detailed record of each farm's participation in wheat and feed grain programs was obtained from the county ASC office. A second visit was made to each farm

after all the data were summarized and the budgets constructed to check on the accuracy of the information. Short-run and long-run linear programming models have been constructed for each farm. Preliminary tests have been made on the adequacy and logical consistency of these models. Sources of differences between actual response and optimum organization of each farm will be investigated.

#### F. Appraisal of Adjustments in Rice Areas

In a study of adjustments in rice areas in the South, emphasis has been placed on aggregating to area and regional totals. Southern rice areas encompass sufficient land well suited to rice production (and water for irrigation) to maintain approximately 3.6 million acres of rice, or slightly over 3 times the acreage grown under allotments in 1964. With rice priced at \$4.00 per 100 pounds and competing enterprises (soybeans, cotton, beef cattle, etc.) priced at the projected supply-demand equilibrium level, farmers in these areas would maximize incomes by planting about 3.3 million acres of rice, or about 90 percent of the potential annual acreage. Some rice would be planted in the southern producing areas if the price received were as low as \$2.30 per 100 pounds. Within the range of \$2.30 to \$4.00 farmers would make the largest response to an increase in price at about \$2.65 to \$2.75 per 100 pounds. This 10-cent change in price would bring in about 0.8 million acres, and expand production (over that produced at \$2.65) by about 32 million hundredweight of rough rice. At \$3.00 per 100 pounds, the acreage planted would be slightly less than 2 times the acreage grown under allotments in 1964. Soybeans are the strongest competitor with rice for land in the southern producing areas. With soybeans priced at \$1.80 per bushel (the projected equilibrium price), a price of about \$2.75 per 100 pounds is sufficient to maintain a large rice acreage in all areas except the Mississippi River Delta. In the Delta, rice must be priced at about \$3.00 per 100 pounds to compete effectively with soybeans priced at \$1.80 per bushel, and if soybeans were priced at \$3.00 per bushel rice would have to be priced at about \$4.00 per 100 pounds to compete as effectively for land and other resources. Two publications are in varying stages of review. One is the regional summary prepared by the study group showing adjustments that would maximize returns to farmers with no restrictions on rice or other crops, and prices set at the estimated supply-demand equilibrium level. The other, which is applicable to the Mississippi River Delta, is "Effects of Allotments and Price Changes in Optimum Plans for Rice Farms in the Mississippi River Delta."

The rice areas of the Sacramento Valley of California have been delineated into 6 primary producing regions on the basis of rice yield and water availability or cost. The rice farms in these areas have been arrayed and classified according to rice acreages and farmland. Data have been assembled to compute the present and potential acreages of rice land within these areas. Data on water costs have also been assembled.

G. Appraisal of Adjustments in Feed-Livestock Areas

The cooperative regional study of adjustments in hog and beef cattle production (Regional Research Project NC-54) is progressing in the aggregation phase. Some shortcomings in assumptions in the model have been detected. The results indicate, for example, that if the Corn Belt were optimally organized, the region would be a feed deficit area. Also, the total use of hired labor would exceed current supplies. These and other shortcomings in the model were noted and appraised in a report to the NC-54 and NCR-4 committees last spring. This report is being prepared as a regional publication. The techniques of the analysis are being revised to include area models which permit interfirm transfers of resources and intermediate products, such as land and feed grains, and permit competition between firms for inputs such as labor and feeder cattle.

The cooperative Regional Research Project (W-79) on an economic analysis of range and ranch management decisions concentrated during the year on an analysis of the current structure and financial situations on representative ranches. The Division is cooperating in the work in California, Oregon, Montana, Colorado, and Texas.

In California, 314 interviews have been obtained from a representative cross section of California range cattle and sheep ranches. The resource, investment, organization, production, and cost data from these interviews were summarized and will be used to provide an essential basis for analyzing the effects of changing economic and environmental factors upon representative livestock ranching operations. From the sample data, 70 representative livestock ranch budgets have been developed to depict 49 cattle and 21 sheep operations in 8 geographic areas of California. The data from the representative livestock budgets are being utilized to construct a behavioral simulation model for livestock ranches incorporating elements of statistical decision theory. The computer simulation model analyzes the ranch firm's decision process over time. Stochastic elements for livestock prices and range conditions are incorporated into the model to simulate the uncertain environment of the ranch firm. Changes in certain economic and institutional parameters are inserted in the model in an effort to determine their effect upon the behavior and the adjustment process of the firm. The immediate focus of this "positive" model is to simulate the ranchers' behavior and adjustment to both increases in land values and taxes in California. These problems are of immediate concern to both California and western livestock ranchers. Later, the model will be adapted to allow study of size, livestock inventory, cost, and investment problems in the California range-livestock industry.

Work was also started on an aggregate supply response study for California range-livestock (cattle) ranches. The basic problem under consideration is that of predicting the production response to structural changes within the range-livestock industry. Two general estimating techniques are being considered: Linear programming and its modifications (e.g., recursive programming and dynamic linear programming), and regression.



In Oregon, an analytical model has been developed which can be used for predicting production response and estimating profitable production potentials on Oregon ranches. A difficult problem in the procedure has been to obtain adequate data to establish input-output relationships and prices for the cattle ranches in the study area. The results of the study will be reported in a PhD thesis and an Oregon Experiment Station bulletin.

In Texas, 21 cow-calf ranch budgets representative of ranch resource situations in the High Plains and Rolling Plains Land Resource Areas have been completed. These ranches range in size from 48 to 2,847 animal units with a median of 146 animal units. Budget data have been summarized in the form suggested by the W-79 Regional Research Project committee. Returns to capital and management range from -\$1,576 to \$126,846 with a median of \$2,406. Returns to capital and management average \$22.79 per animal unit and \$1.06 per acre. Returns to capital and management vary from -\$34.92 to \$79.20 per animal unit and from -\$1.64 to \$5.19 per acre. Investment in land, buildings and improvements, and livestock range from \$85,325 to \$4,605,987 with a median of \$286,103. Returns on investment vary from -1.96 percent to 5.15 percent. Returns on investment generally increase as ranch size increases, and as the ratio of cropland to rangeland increases.

A paper entitled "Economies of Various Mechanical Methods of Controlling Brush" was presented at the Brush Control Seminar at Texas A & M University. Papers presented at this seminar are being used to answer questions that various individuals and livestock organizations have been asking concerning what is being done and what needs to be done to develop an effective brush control program.

Also in Texas, an evaluation is being made of the economic benefits from alternative grazing practices and livestock combinations, based on 7 years of experimental data from pastures at the Barnhart Station in the Edwards Plateau (West). Yearlong grazing by straight cattle (cow-calf) and straight sheep were compared with yearlong grazing of a 0.6-0.4 cattle-sheep combination at a constant stocking rate. Also, yearlong systems were compared with 2-pasture and 4-pasture deferred rotation grazing systems for the 0.6-0.4 cattle-sheep combination. Preliminary results indicate that the greatest net returns per acre or per animal unit are obtained from a 0.6-0.4 cattle-sheep combination for the 2-pasture rotation system. Work was continued in the development of budgets for the 17 ranch resource situations in the Edwards Plateau and Central Basin Land Resource Areas. Data obtained from a mail survey made in 1965 and follow-up surveys by the Texas A & M Statistics Institute and SRS will be used to strengthen input-output data in the ranch budgets, and to estimate benefits of the screwworm control program at the ranch level.

In Colorado, initial work has consisted of the delineation of 4 ranching areas: The mountain valleys of the southern Rocky Mountains with summer grazing at high altitudes; the Central High Plains in northeastern Colorado; the Southern Plains area of southeastern Colorado; and the desert and semi-desert areas of western Colorado. First priority is given to the Rocky

Mountain and Central High Plains areas. The Southern Plains area is represented through work in New Mexico, and the western desert areas through work in Utah. Data from the Bureau of Land Management, Forest Service, ASCS, and other secondary sources were used to classify and stratify the ranch population and to furnish a basis for developing a sample of ranchers for personal interviews. Approximately 5 representative ranches will be selected in the Rocky Mountain area consisting of 3 sizes of cattle ranches; 1 combination cattle-sheep ranch--primarily cattle; and 1 combination sheep-cattle ranch--primarily sheep. In the Central High Plains area, 3 sizes of cattle ranches will be required. The enumerative survey of a sample of ranches in both areas has been completed. Tabulation and analysis of the survey data are underway.

In Montana, progress has been delayed by changes in personnel. Drafts of 2 manuscripts "Detailed Summary of the Organizational Structure of Montana's Beef Cattle Industry," and "Descriptive Analysis of the Organizational Structure of Montana's Beef Cattle Industry," have been prepared. Revision for publication is underway.

Studies of the economics of cattle feeding in Arizona, eastern Nebraska, and the South Platte Valley of Colorado progressed in the preparation and revision of reports of results for publication. The reports review and interpret economic trends affecting cattle feeding in each region, the economics of size of feedlots, and potential interregional competition. In Arizona, progress on the study was delayed by essentially full-time assignment of personnel to other research.

#### H. Appraisal of Agricultural Policies and Programs

A study of 446 farms in the Cropland Conversion Program in 12 areas showed no significant differences between CCP farms and other commercial farms in their respective areas in such factors as acres in farm, percentage of land used for crops or the proportion of cropland accounted for by base or allotment crops. Crop yields on CCP farms tended to be above average. However, some ASC committees were much more generous than others in appraising the quality of the land, and hence the payment offered, for land in the program. The 1964-65 Cropland Conversion Program was a pilot program in 100 counties that offered farmers payments for converting land from row crops and small grains to conserving uses under 5- to 10-year contracts. Nearly all land in the program was converted to pasture. Farms in the program had more cattle per acre compared with their respective area averages, and most CCP participants were planning further increases in cattle numbers. The year before entering the program, 41 percent of the land on sample farms was in row crops and small grains, 30 percent in hay and pasture, and 26 percent was diverted under Government programs. The program caused little change in the acreage used for hay, but there was considerable variation from area to area in the relative reduction in acres of row crops and small grains versus reduction in acres of idle, fallow and diverted land. About a third of the acreage would not have been used for crop production in 1965 in the absence of the CCP.

Although payments for participating in programs other than CCP were reduced when land was placed under CCP agreements, total program payments increased in 10 of the 12 areas studied. Many farmers, however, invested all of their payments and more in soil improvement, livestock, fences, and other farm improvements. Output reduction, for each farm as a whole, per dollar of program costs ranged from \$0.67 to \$3.87. Payment rates were tied to productivity, but there was no correlation between payment per acre and output reduction per dollar of program costs. Off-farm employment did not change as a result of participation in CCP. The chief source of supplemental income other than off-farm employment was Social Security or some other form of old age assistance or pension. In 5 of the 12 sample areas more than half of the CCP participants had off-farm incomes of \$2,000 or more in 1964; in Georgia, 70 percent of them had \$5,000 or more. More than 3/4 of the farmers intended to leave their CCP land in grass after the agreements expired, and they expected that their incomes would be higher in 1970 and later years than they would have been if they had not participated in the program.

About a third of the time of the Farm Program Appraisal staff was devoted to assisting ASCS and the Staff Economist Group in the Office of the Secretary in estimating production requirements and desirable levels of diversion under the 1966 Annual Feed Grain and Wheat Programs and the long-term Cropland Adjustment and Cropland Conversion Programs, and in estimating acreage requirements for 1967 and adjustment needed in farm programs to obtain these acreages of crop production.

#### I. Cotton Cost Analysis

The results of a comprehensive enumerative survey of cotton production practices and costs on about 5,200 cotton farms are reported in the publication "Costs of Producing Upland Cotton in the United States." This survey was conducted in February and March 1965 to obtain the basic data on production practices and costs for the 1964 cotton crop. A survey of 1965 crop costs on about 4,700 cotton farms was conducted in February and March 1966, and results are now being processed. These data are intended to fulfill the provision in the Agricultural Act of 1964 (PL 88-297) that the Secretary of Agriculture should consider, among other factors, the cost of producing cotton in setting price support levels for cotton. As part of the Department's expanded research on means of reducing cotton production costs, the surveys also provide the aggregative data required in appraising cost reduction potentials in cotton production. The surveys were conducted in 18 major cotton production regions and provide data on production costs and inputs for these regions, as well as for 3 selected size-of-farm groups per region.

Allowing market rates of return to all inputs used, the total cost of producing the U. S. crop of upland cotton in 1964 was 28.4 cents per pound of lint. When costs of land and items of farm overhead are excluded, total direct cost was 21.6 cents. About 64 percent of all U. S. cotton was produced at a total cost of less than 30 cents per pound, and about 88 percent



at a direct cost of less than 30 cents. The guideline of 30 cents is close to the average of 29.3 cents per pound of lint received by survey respondents for their cotton in 1964. Estimates of total cost per pound of lint varied from an average of 23.4 cents in the Mississippi Delta region to an average of 38.1 cents in the Upper Rio Grande-Trans Pecos region of Texas and New Mexico. When unpaid family labor and owned production assets are valued at market rates, the largest farms have distinctly lower costs per pound of lint than do small farms. The difference typically is 8 to 10 cents per pound. Within each of the 18 regions, higher yields are associated with lower costs per pound. Any attempt to reduce costs of producing cotton should emphasize reductions of labor, power and equipment costs, which comprise a substantial proportion of total costs in all regions.

In several States, progress has been made on cooperative research on cost reduction in producing cotton. Relationships among power and equipment, labor requirements, labor overhead, capital use, and managerial requirements are being studied in the Yazoo-Mississippi Delta. Data obtained from cooperating farmers show that when used with tractors of 60 or more horsepower the performance rate of 6-row tillage equipment exceeds that of comparable 4-row equipment by 55 to 65 percent under farm conditions. In both 1965 and 1966 some of the farmers in the study changed from 4-row to 6-row equipment with a substantial reduction in the number of tractors and laborers needed to operate their farms. Cost and returns data on cotton produced in 1965 were obtained from a selected group of farmers in 4 cotton-producing areas of Tennessee and from experimental cotton plots on the Ames plantation. The study in Tennessee will determine the conditions under which selected new production practices will pay and provide basic input-output data for more comprehensive analysis of alternative methods of producing cotton.

In 1965 a sample of farmers who have made innovations in cotton production practices was interviewed in the Coastal Plain area of South Carolina. Data were obtained on practices in land preparation, fertilizing and seeding, weed control, insect control, mechanical harvesting, and marketing. The 1965 schedules have been coded and edited, and the data transferred to data cards. A 3-phase mail questionnaire has been developed for obtaining information from the sample farmers concerning the 1966 cotton crop. A study with similar objectives and procedures is underway in cotton areas in Georgia.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. National and Regional Productivity in Agriculture

Barton, G. T. 1966. Our food abundance. 1966 Yearbook of Agriculture.

Barton, G. T. and Durost, D. D. 1965. Contribution of productivity to growth in U. S. farm output. National Productivity Council Jour. (New Delhi, India) 6(2 and 3), pp. 257-264.

Farm Production Economics Division. 1966. Changes in farm production and efficiency. Stat. Bul. 233 (revised). 36 pp.

Farm Production Economics Division. 1966. Changes in farm production and efficiency. Index numbers of farm production, by groups of livestock and crops, for each farm production region, 1939-65. Stat. Bul. 233 (revised). Sup. 1. 12 pp.

Tweeten, Luther G. and Tyner, Fred H. 1966. The utility concept of net social cost--a criterion for public policy. Agr. Econ. Res. 18(2), pp. 33-42.

B. Appraisal of Production Response and Needs for Adjustment

Heady, Earl O. and Skold, Melvin D. 1965. Projections of U. S. agricultural capacity and interregional adjustments in production and land use with spatial programming models. Iowa Agr. Expt. Sta. Res. Bul. 539. 48 pp.

Heady, Earl O. and Whittlesey, Norman K. 1965. A programming analysis of interregional competition and surplus capacity of American agriculture. Iowa Agr. Expt. Sta. Res. Bul. 538. 41 pp.

Lee, John E., Jr. 1966. Exact aggregation--a discussion of Miller's theorem. Agr. Econ. Res. 18(2), pp. 58-61.

Lee, John E., Jr. and Schaller, W. Neill. 1966. Aggregation, feedback, and dynamics in agricultural policy research. N. C. St. Univ., Agr. Policy Inst. Price and Income Policies, pp. 103-114.

Martin, Neil R., Jr., Partenheimer, Earl J., and Strickland, P. Leo, Jr. 1965. Implications of allotments on optimum farm organization and supply relationships in two Alabama areas. Ala. Agr. Expt. Sta. Bul. 361. 58 pp.

Martin, Neil R., Strickland, P. L., and Partenheimer, Earl J. 1965. Implications of alternative cotton acreage allotment levels. Jour. Farm Econ. 47(5), pp. 1203-1207.

Miller, Thomas A. 1966. Sufficient conditions for exact aggregation in linear programming models. Agr. Econ. Res. 18(2), pp. 52-57.

Schaller, W. Neill. 1966. Estimating aggregate product supply relations with farm-level observations. Proceedings, Conference on Production Economics in Agricultural Research, Univ. of Ill., pp. 97-112.

Schaller, W. Neill. 1965. Recursive models for studying aggregate production adjustments--with implications for range livestock research. WAERC, Committee on the Economics of Range Use and Development. Rpt. 7, Goals and Public Decision-Making in Range Resource Use, pp. 89-109.

Skold, Melvin D. and Heady, Earl O. 1966. Regional location of production of major field crops at alternative demand and price levels, 1975. USDA Tech. Bul. 1354. 63 pp.

Stovall, John G. 1966. Sources of error in aggregate supply estimates. Jour. Farm Econ. 48(2), pp. 477-480.

Tyner, Fred H. and Tweeten, Luther G. 1965. A methodology for estimating production parameters. Jour. Farm Econ. 47(5), pp. 1462-1467.

Whittlesey, Norman K. and Heady, Earl O. 1966. Aggregate economic effects of alternative land retirement programs. USDA Tech. Bul. 1351. 54 pp.

C. Appraisal of Adjustments in Dairy Areas

Christensen, R. L., Andrews, R. A., Frick, G. E., and Harrington, D. H. 1965. Production and income effects of a Class I base program on New England dairy farms. N. H. Agr. Expt. Sta. Res. Mimeo. 39. 37 pp.

Duvick, Richard D. 1966. Part-time farming in two areas of southern Michigan, 1959 and 1963: changes and similarities. Mich. Agr. Expt. Sta.

Kimball, N. D. 1966. Costs and returns for large Wisconsin dairy herds. Wis. Agr. Expt. Sta. Bul. 579. 18 pp.

Tix, Paul E. and Sundquist, W. B. 1966. Use of a producer panel to estimate changes in agricultural production in Minnesota's dairy belt. Minn. Agr. Expt. Sta. Tech. Bul. 251. 18 pp.

D. Appraisal of Adjustments in Cotton Areas

Burch, Thomas A. and Hubbard, John W. 1966. Effects of changes in cotton allotments and prices on farm incomes and organizations in South Carolina. S. C. Expt. Sta. Bul. 528.

Connor, Larry J. 1965. Off-farm employment of farm operators in north central Oklahoma in 1964. Okla. Current Farm Econ. 38(3). 88 pp.

Gilliam, H. C., Jr. 1965. Farm adjustments for changing conditions: II. tobacco farms, South Carolina. S. C. Agr. Expt. Sta. Bul. 519. 81 pp.

Hatch, Roy E. and Moore, D. S. 1966. Effects of changes in the price of cotton and in levels of cotton allotments on aggregate farm production in the Lower Rio Grande Valley of Texas. Texas Agr. Expt. Sta. MP-802. 40 pp.

Martin, N. R., Jr., Partenheimer, E. J., and Strickland, P. L., Jr. 1965. Implications of allotments on optimum farm organization and supply relationships in two Alabama areas. Ala. Agr. Expt. Sta. Bul. 361. 58 pp.

Pawson, Walter W. 1966. Acala 1517 commands five-cent premium over Deltapine. Cotton--A College of Agriculture Report. Univ. of Ariz. Col. of Agr. Ser. P-4, pp. 111-112.

Pawson, Walter W. and Nelson, Aaron G. 1966. Will it pay to grow skip-row cotton in 1966? Cotton--A College of Agriculture Report. Univ. of Ariz. Col. of Agr. Ser. P-4, pp. 113-114.

Pawson, Walter W. and Nelson, Aaron G. 1966. Estimated yields, costs and returns for solid planted upland cotton in 1966, by counties. Cotton--A College of Agriculture Report. Univ. of Ariz. Col. of Agr. Ser. P-4, pp. 114-119.

Pawson, Walter W. and Nelson, Aaron G. 1966. Comparison of upland cotton and long-staple cotton yields, costs and returns, by counties. Cotton--A College of Agriculture Report. Univ. of Ariz. Col. of Agr. Ser. P-4, pp. 119-121.

Pawson, Walter W. and Nelson, Aaron G. 1966. Economics of skip-row cotton production. Ariz. Agr. Expt. Sta. Rpt. 231. 19 pp.

Strickland, P. L., Jr. and Partenheimer, E. J. 1966. Minimum open land requirements for specified farm incomes, Limestone Valley areas, Alabama. Ala. Agr. Expt. Sta. Agr. Econ. Ser. 9. 50 pp.

Sutherland, J. Gwyn. 1966. Effects of cotton price and allotment variations on farm organizations and incomes, eastern piedmont and upper coastal plan (economic areas 6 and e), North Carolina. N. C. Agr. Expt. Sta. A. E. Inform. Ser. 126. 30 pp.



Workman, Herman E., Schneeberger, Kenneth C., Lagrone, William F., and Walker, Odell L. 1966. Alternative crop enterprises on major upland soils of east central and south central Oklahoma: resource requirements, costs and returns. Okla. Agr. Expt. Sta. Proc. Ser. P-523. 38 pp.

E. Appraisal of Adjustments in Wheat Areas

Larson, Donald K. and Thompson, Layton S. 1966. Variability of wheat yields in the Great Plains. ERS-287. 38 pp.

Sitler, Harry G. 1966. Crop enterprise costs for southeastern Colorado. Colo. Agr. Ext. Serv. Unnumbered publication. 16 pp.

Sitler, Harry G. 1966. Crop enterprise costs for northeastern Colorado. Colo. Agr. Ext. Serv. Unnumbered publication. 17 pp.

Tix, P. E., Anderson, Dale O., Loftsgard, Laurel D., and Krenz, Ronald D. 1965. Production adjustments, a case study of six south central North Dakota farms. N. Dak. Agr. Expt. Sta. Bul. 456. 31 pp.

Whittlesey, N. K. and Cagle, A. J. 1965. A linear programming analysis of wheat program choices. Wash. Agr. Ext. Serv. E.M. 2567. 9 pp.

F. Appraisal of Adjustments in Rice Areas

Mullins, Troy. 1966. Production requirements and estimated costs and returns for rice and beef cattle under alternative rotation programs in the Coast Prairie, Texas. Texas Agr. Expt. Sta. MP-801. 20 pp.

G. Appraisal of Adjustments in Feed-Livestock Areas

Boykin, Calvin C., Caton, Douglas D., and Rader, Lynn. 1966. Economic and operational characteristics of Arizona and New Mexico range cattle ranches. ERS-260. 25 pp.

Boykin, C. C. and Eddleman, B. R. 1965. Annual cost of maintaining the beef cattle herd. Proceedings, Third Coordinated Beef Improvement Conference, Texas A & M Univ. and Texas and Southwestern Cattle Raisers Association, pp. 45-48.

Heagler, A. M., Cooke, F. T., Jr., and Tramel, T. E. 1965. The place of cow-calf enterprises in farming systems in the Yazoo-Mississippi Delta. Miss. Agr. Expt. Sta. Bul. 719. 16 pp.

Schneeberger, Kenneth C., Workman, Herman E., Halbrook, Waymon, and Walker, Odell L. 1966. Resource requirements, costs and expected returns, beef cattle and improved pasture alternatives, east central and south central Oklahoma. Okla. Agr. Expt. Sta. Proc. Ser. P-544. 48 pp.

Skold, M. D. and Epp, A. W. 1966. Optimal farm organizations for irrigated farms in south central Nebraska. Nebr. Agr. Expt. Sta. Bul. 222. 39 pp.

Tweeten, Luther G., Reichardt, Alan W., and Lagrone, William F. 1965. Profitable plans for farms in the major bottomlands of south central and east central Oklahoma. Okla. Agr. Expt. Sta. Bul. B-641. 40 pp.

U. S. Department of Agriculture. 1965. Effects of changes in grazing fees and permitted use of public rangelands on incomes of western live-stock ranches. ERS-248. 33 pp.

Van Arsdall, Roy N. 1966. Labor requirements, machinery investments and annual costs for the production of selected field crops in Illinois, 1965. Ill. Agr. Expt. Sta. AE 4112. 43 pp.

Van Arsdall, Roy N. 1965. Resource requirements, investments, costs, and expected returns from hog production systems in Illinois, 1965. Ill. Agr. Expt. Sta. AE 4074. 45 pp.

Van Arsdall, Roy N. 1965. Resource requirements, investments, costs, and expected returns from selected beef-feeding and beef-raising enterprises. Ill. Agr. Expt. Sta. AE 4075. 67 pp.

#### H. Appraisal of Agricultural Policies and Programs

Bolton, Bill and St. Clergy, Clyde. 1966. Allotment levels and planting patterns under the new cotton program. La. Ext. Serv. and La. St. Univ. Dept. of Agr. Econ. and Agribus. Unnumbered. 31 pp.

#### I. Cotton Cost Analysis

Starbird, I. R. and Hines, F. K. 1966. Costs of producing upland cotton in the United States, 1964. Agr. Econ. Rpt. 99. 46 pp.

#### RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

Amick, R. J. and Allison, J. R. 1965. Minimum land requirements for specified levels of income for general crop-livestock farms in the Piedmont of Georgia. Ga. Agr. Expt. Sta. Bul. N.S. 146.

Feuerbach, R. and Cramer, C. Trends in livestock. Mo. Agr. Expt. Sta. Bul. 830.

Feuerbach, R. and Miller K. Trends in crops. Mo. Agr. Expt. Sta. Bul. 837.

Feuerbach, R. and Whitted, S. Trends in dairy. Mo. Agr. Expt. Sta. Bul. 839.



Seamus, J. Sheedy and McAlexander, R. H. 1965. Selection of representative benchmark farms for supply estimation. Jour. Farm Econ. 47(3), pp. 681-695.

Tweeten, Luther G. and Hines, Fred K. 1965. Contributions of agriculture productivity to national economic growth. Agr. Sci. Rev. 3(2), pp. 40-45.

Young, Robert. 1965. An economic study of the eastern beet sugar industry. Mich. Agr. Expt. Sta. Res. Bul. 9.

## AREA NO. 2. ECONOMICS OF FARM MANAGEMENT AND CONSERVATION PRACTICES

Problem. There are marked differences among the major agricultural areas in the physical and economic environment which determine the possibilities and limitations on successful operation of farms. More information is needed for each type of farming region on the patterns of production resources and systems of farming used by individual farmers; the production requirements and output obtained from various enterprises with different methods of operation, including especially those practices that aid in soil and water conservation; the relationships between size of operations, combination of enterprises, production practices used, efficiency in production, and farm financial returns; and alternative opportunities for desirable adjustments, particularly those which conserve soil and water, on farms of different sizes, types, and physical conditions.

### USDA AND COOPERATIVE PROGRAM

A continuing long-term program of research dealing with the economics of farm management practices is conducted in cooperation with 10 State Experiment Stations. In the Lake States and Northeast, emphasis is on input-output relationships for dairy, forage, and poultry. In the Corn Belt, research emphasizes practices in the production of feed grains and hogs. In the South, emphasis is on mechanization and other emerging technologies in cotton and rice production. In the West, a special study was made of the potentialities of sugarbeet production. Studies of the economics of conservation practices are emphasized in Missouri and Texas. While major attention is given to determining input-output relationships, emphasis is also given to economic analyses within the framework of profitability of the practices to the farm as a whole.

A total of 2.0 Federal scientific man-years was devoted to this area of research -- 0.5 man-years in economics of farm management practices and 1.5 in economics of conservation practices.

### PROGRAM OF STATE EXPERIMENT STATIONS

A total of 45.9 scientist man-years is devoted to this area of research.

### PROGRESS -- USDA AND COOPERATIVE PROGRAM

#### A. Economics of Farm Management Practices

A report, "Economic Effects of Alternative Market Egg Production Organizations" was prepared for publication. This study, made in Connecticut, focused on adjustment opportunities associated with egg collection and egg processing since these are the most time-consuming operations on poultry

farms. Cost reduction opportunities were based on optimal systems of production derived by linear programming. Most of the cost reduction opportunities are obtainable with an annual output of 400,000 dozen eggs; from this output to a million dozen, costs are nearly constant. This project will be discontinued with the publication of the report.

The 1964 records of 148 farmers in southwestern, and 155 farmers in southeastern Minnesota were summarized and reports of major results published. An analysis was made of the last 25 years of records of the southeastern area, and trends in receipts and expenses for the period were analyzed. In southwestern Minnesota, labor earnings for 1964 were considerably higher than they have been for a number of years. This was primarily due to larger sales of cash crops and higher returns from feeding cattle and hogs. The analysis of the 25 years of records showed an increase in size of farms, capital managed, and gross income. A very marked change has been the large increase in cattle feeding. In southeastern Minnesota, 1964 earnings were about the same as in 1963. Crop yields, amount of livestock maintained, and returns from livestock showed little change. For the 25-year period, farmers increased the acreage operated and their emphasis on dairying. Results from this project are used extensively as a basis for input-output data in other studies of farm organization and management. The results are also used extensively by farm management extension specialists, teachers of vocational agriculture, lending agencies, and other farm advisors.

Research that deals with the economic problems of the Belle Fourche Irrigation Project and the surrounding area of influence was continued. Data have been obtained on farm and ranch costs and returns, credit, cropping practices, and obstacles to integration and progress that will be useful in recommending practices and adjustments needed in farming and ranching in the area to obtain the optimum income and use of area resources. A report is being prepared which includes information on the debt status of the irrigated and dryland farms and ranches, the amount and kind of integration and cooperation between irrigated and dryland farms, opinions of the farmers and ranchers concerning obstacles to further cooperation, and the possibility of increased livestock feeding by irrigation farmers. Representative farms and ranches were developed for irrigated and dryland conditions: Five irrigated farms varying from 160 to 4,640 total acres with a range of 60 to 550 irrigated acres of cropland, 4 dryland farms with a range of 520 to 5,560 acres, and 4 ranches varying in size from 4,080 to 33,000 acres. In the on-Station work, in cooperation with Station personnel of the Agricultural Research Service and the South Dakota Experiment Station, the irrigated pastures study was continued. This year steers were grazed on both the developed and undeveloped irrigated pastures. The study on different methods of pond or reservoir lining was continued. Plastic lining was installed in the third pond. The planned report on the range fertilization and water spreading was not completed because the ARS personnel involved decided to include data for the 1966 season.



In an economic evaluation of alternative systems of hog production and their integration into systems of Corn Belt farming, work during the year consisted largely of keeping abreast of developments in facilities and management practices on an informal basis. Formal study of hog production was conducted in a project dealing with the economies of size of hog farms. Major developments in hog production include a continued trend toward slotted floors with holding pits beneath the floors for all confinement facilities. Manure is held in these pits until it is convenient for the farm operator to spread it on cropland. This generally means a settling tank in addition to the pit beneath the floor to take care of overflow materials and a lagoon for excess liquid. Cost of confinement structures is increasing partly because of the more expensive manure-handling facilities and partly because of more environmental control features built into the facilities. The newest slotted-floor farrowing houses cost nearly \$500 per sow space.

An economic evaluation of diuron and trifluralin when used as preemergence herbicides in cotton has been initiated. For several years the most widely used and effective preemergence herbicide for cotton has been diuron. In 1964 a new product, trifluralin, became available for use as a preemergence herbicide for cotton. This material has become widely used by farmers in the Mississippi Delta. It is considerably more expensive than diuron and must be mixed into the soil to be effective. Several advantages are claimed for this material. As it is mixed into the soil, it does not require rainfall to activate it as diuron does. Further, it is claimed that trifluralin will give better and longer lasting weed control than diuron. It is also claimed that if trifluralin is applied broadcast to an entire field, the number of cultivations, use of post emergence herbicides, and hand-hoeing labor are considerably less than when diuron is used.

An experiment has been set up in cooperation with the Delta Branch Experiment Station at Stoneville, Mississippi, to determine total weed control costs in cotton associated with the use of these two herbicides. Eighty-four acres of 4 x 4 cotton was planted on the Station in 1966. This cotton was planted in 4 fields with varying soil types. In each field 6 tests were established: (1) diuron on a bed, (2) diuron flat, (3) band trifluralin on a bed, (4) band trifluralin flat, (5) broadcast trifluralin on a bed, and (6) broadcast trifluralin flat. For each of these tests in each field all inputs including materials, labor, and machinery time were measured. From these data total weed control costs for each test will be determined. The growing season has been dry and grass and weed control has not been a great problem. All inputs for weed control have been the same except in 1 replication of 1 test. This test, broadcast trifluralin used in flat planted cotton, has had only 2 cultivations, no post-emergence herbicide applications, and no hand hoeing. This study will be repeated in 1967.

An economic analysis of an experimental mechanical boll weevil flail under development at the Regional Boll Weevil Laboratory at State College, Mississippi, was made. A report has been drafted for submission for publication.



The economics of sugarbeet production in Arizona was analyzed. Arizona was granted an allocation from the National Sugar Beet Acreage Reserve to produce 20,000 acres of sugarbeets, beginning in the fall of 1966. Information was needed by farmers on the probable costs and returns for this new crop, and on the investment requirements and operating costs for new types of machinery and equipment required. A report was issued on the economics of investment in machinery and equipment for sugarbeet production. The larger the acreage on which machinery is used, the lower are the machinery costs per acre. For farmers who have small acreages of beets, it would be less expensive to hire a custom operator to plant, thin, and cultivate the beets than to buy equipment. Substantial reductions in cost could be achieved by all sugarbeet growers through joint ownership of equipment. It was estimated that through joint ownership and operation of machinery, beet-harvesting costs could be cut in half as compared with charges for custom harvesting.

A study of adjusting to increasing salinity on dry-farmed lands in the Rio Grande Valley was carried into its fourth year. Information collected to date indicates that definite operating patterns or bundles of practices are associated with specific crops more than with variations in saline conditions. If data collected during the remainder of this crop year continue to show this trend, the study will be terminated and a report prepared.

#### B. Economics of Conservation Practices

An economic appraisal was made of the use of water for irrigation on southeastern Missouri farms. Field experiments with corn are being conducted at the Delta Research Center, near Portageville in southeastern Missouri. Variables included in the experiment are plant populations, rate of nitrogen fertilization, and moisture level. Corn yield data from a 10-year date-of-planting study are being analyzed in an attempt to determine the influence of moisture, temperature, and other climatological variables during selected growth periods on corn yield. If satisfactory relationships are obtained, they will be used to determine the economic feasibility of selected irrigation programs. Several regression models relating precipitation, temperature, planting date, and variety were fitted to data from the 10-year date-of-planting study of corn. A refinement of one of the models does a "good" job of predicting corn yields if tasseling date is known. The model accounts for 84 percent of the variation in yield, and the signs of the coefficients are logically consistent although not all the coefficients are statistically significant. An interesting relation emphasized by the model is that high temperatures have a highly depressing effect on corn yields even though moisture may be at a level which is normally considered adequate under Missouri conditions. The major deficiency in the equation is that it does not give good estimates of yield during cool-dry years or hot-moist years. This result is not surprising, as conditions such as these were not available in the sample data. The estimated relationship was used in conjunction with long-term weather data to estimate yields, net returns, and associated probability distributions for these measures. An economic analysis of the

data involving aspects of the feasibility of supplemental irrigation and optimum planting date is underway.

The third year of a controlled field experiment designed to determine the relationship between nitrogen fertilization and soil moisture levels was conducted in southeastern Missouri near Sikeston instead of Portageville as it had been the previous 2 years. Sufficient rainfall fell throughout the growing season to negate any yield differences due to varying soil moisture levels. Yield differences were largely associated with date of planting and nitrogen fertilization. Tabulation of results was completed, but further analysis will be delayed pending the completion of additional tests.

An assessment was made of the progressive economic impact and the expected life of decreasing water resources in Subdivision No. 1 of the Texas High Plains underground water reservoir. Use in excess of recharge is depleting the water supply for some 3.5 to 4.0 million acres of irrigated land in the Texas High Plains. Depletion is reflected by a decline in water levels ranging from about 6 feet on the peripheries to more than 120 feet in some of the older developed areas. The decline in water levels results in increased pumping lifts and decreased well capacities, both of which have an adverse effect on farm income. Water costs are increased and the quantities that can be made available are reduced by each subsequent decline in water levels. The decline in water levels is a continuing process that differs from year to year and from one resource situation to another depending on the length of the pumping season and the extent to which the water supplies have been depleted. Adjusting to meet the change in water supplies has raised unit water costs some 200 to 400 percent since 1949. There is no reason to expect that future declines in water level and their effects will differ from those of the past. Thus the immediate problem becomes one of assessing the effects of increasing water costs and declining supplies on farm income.

This study is designed to evaluate the progressive impact of increasing water costs on production and net farm income, and to estimate the period of time through which irrigation can be profitably practiced in specific resource situations. Work to date has indicated that the effects of declining water supply differ considerably from place to place, depending largely on the thickness and porosity of underlying saturated materials. As basis for assessment, the study area has been delineated into resource areas based on the present thickness of the saturated zones, porosity of materials, and static water levels. The area involved in each of these resource situations has been determined. Land use, water use, and water extraction patterns peculiar to these resource situations have been developed. Farm budgets reflecting input-output levels with alternative irrigation programs in the mixed and sandy land portions of the study area are well along. Present and prospective water costs in the various resource situations are in process of development. Many of the basic data compiled in the study are being used by the Texas Agricultural Extension Service in area economic development reports. Copies of the same materials have been requested by, and forwarded to,

the Austin, Texas office of the U. S. Geological Survey, and the High Plains Underground Water Conservation District No. 1 at Lubbock, Texas.



PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Economics of Farm Management Practices

Aanderud, W. G., Plaxico, J. S., and Lagrone, W. F. 1966. Income variability of alternative plans, selected farm and ranch situations, Rolling Plains of northwest Oklahoma. Okla. Agr. Expt. Sta. Bul. B-646. 78 pp.

Campbell, George W., Pawson, Walter W., and Nelson, Aaron G. 1965. Sugarbeets: estimated costs and returns -- a preliminary report. Ariz. Agr. Ext. Serv. mimeo. 12 pp.

Hutcherson, W. H., Hagan, A. R., and Doll, J. P. 1965. Farm plans for a 200-acre central Missouri farm -- a comparative analysis of the economic potential for alternative farming systems. Mo. Agr. Expt. Sta. Res. Bul. 901. 43 pp.

Laughlin, R. E., Hagan, A. R., and Doll, J. P. 1965. An economic analysis of alternative beef cattle systems for a large farm in central Missouri. Mo. Agr. Expt. Sta. Res. Bul. 895. 54 pp.

Myers, K. H. 1966. Facts for prospective farmers. U. S. Dept. of Agr. Farm. Bul. 2221. 22 pp.

Nodland, T. R. and Engene, S. A. 1965. Trends in farm income and expenses. Minn. Farm Bus. Notes No. 476. 2 pp.

Nodland, T. R. 1966. 1965 Annual report, southwestern Minnesota farm management service. Univ. of Minn. Inst. of Agr. Rpt. No. 285. 24 pp.

Nodland, T. R. 1966. 1965 Annual report, southeastern Minnesota farm management service. Univ. of Minn. Inst. of Agr. Rpt. No. 286. 25 pp.

Pawson, Walter W. and Nelson, Aaron G. 1966. Sugarbeets: economics of machinery investment. Ariz. Agr. Expt. Sta. Rpt. 238. 12 pp.

Schroeder, J. J., Jr. and Hagan, A. R. 1965. Alternative systems of farming for a medium-size farm in central Missouri. Mo. Agr. Expt. Sta. Res. Bul. 897. 52 pp.

Walch, H. N. and Nodland, T. R. 1966. Feeder cattle costs and returns 1964-1965. Univ. of Minn. Inst. of Agr. Rpt. No. 287. 28 pp.

B. Economics of Conservation Practices

Christiansen, R. A. and Staniforth, S. D. 1965. Potential benefits on farms from watershed development. Univ. of Wis. Dept. of Agr. Econ. AE 46. 20 pp.



Myers, K. H. and McAlexander, R. H. 1966. An inventory of land and soil resources in Pennsylvania. Penn. State Univ. Dept. of Agr. Econ. and Rur. Soc. AE and RS 50. 66 pp.

#### RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

Gray, J. R., Stubblefield, T. M., and Roberts, W. K. Economic aspects of range improvements in the southwest. 1965. N. Mex. Agr. Expt. Sta. Bul. 498.

Headley, J. C. 1966. The management factor in commercial agriculture: how can it be recognized? Jour. Farm Econ. 47(5), pp. 1437-1439.

### AREA NO. 3. STRUCTURE OF AGRICULTURE AND ECONOMICS OF FARM SIZE

Problem. The rapid changes in American agriculture are generating many pressing problems. Foremost are questions on the character and magnitude of current trends in the structure of agriculture. What is happening to various sizes and kinds of farms? How are working relationships between farmers and other businessmen changing? Equally significant are questions about causes and effects. What incentives, monetary and other, bring about changes in the structure of agriculture? How do these changes affect farm people, rural communities, and nonfarm agricultural businesses? These are fundamentals on which research is needed so that policymakers, farm leaders, farm people, and citizens generally can gain depth of understanding and essential information for action.

#### USDA AND COOPERATIVE PROGRAM

Novel forms of vertical coordination and reemphasis on old forms have influenced American agriculture in recent years. Basic analysis has been designed to describe existing kinds of vertical coordination and to provide understanding that can lead to improvements. While past attention was centered on coordination of farm production with marketing stages, interest is now directed also to coordination of input resources.

Changes in the number, size, and characteristics of the farm businesses in which American agriculture is organized are continually measured and interpreted. In analyzing these changes, special attention is given to the relative position of various size groups of farms. These relative positions are being developed in terms of total farm marketings, net farm income and farm investment, use of land and hired labor, the age and tenure of operators, and the organization of farm production by commodities and by farm and nonfarm sectors. Increased attention is being given to the geographic and spatial aspects of changes in the degree of concentration of production and to the extent to which changes in the farm supply and marketing sectors may be accelerating or retarding such trends.

The potential efficiency of various sizes of farms has been determined for each of several types of farms in selected areas. Initially these studies were at the individual firm level, but some have been extended to consideration of the impediments and obstacles these farms will encounter as they strive for more efficient or more profitable sizes and organizations. Several studies are now in the expanded phase of appraising the implications of projected changes in farm size to a type-of-farming area. The Colorado, Illinois, Minnesota, North Carolina, and Washington Experiment Stations were cooperators in studies of the economics of farm size.

The above program of work, concerned essentially with production structure, is being extended to include the farm supply or input and the marketing

structures. Important interrelationships are emerging among the several subsectors of the agribusiness complex that are likely to have increasing implications with respect to the geographic pattern of production and the size and organizational structure of farms.

A total of approximately 7.4 Federal scientific man-years is being devoted to this research area: Vertical coordination and structure, 3.0 man-years; economics of farm size and numbers of farms, 4.4 man-years.

#### PROGRAM OF STATE EXPERIMENT STATIONS

No scientist man-years reported.

#### PROGRESS -- USDA AND COOPERATIVE PROGRAM

##### A. Vertical Coordination and Changing Structure

A report on the working model of a computer simulation for a dairy farm was published. The model, although restricted to management systems on a dairy farm, is capable of extension to many of the decision problems encountered in the vertical structure from farmer to consumer. Steps are presented in Fortran computer language, in flow charts, and in ordinary English. This makes the method readily available for others to use.

A study of the changing structure and performance of the American chemical industry and its coordination with farms was continued. This study traces the evolution of the chemical industry with emphasis on developments that affect the current and prospective structure of farm production, pricing, and consumption. A preliminary draft for a part of the analysis is nearing completion.

"Notes on the structure of the farm supply industries," a descriptive analysis of selected input industries now being prepared will summarize available information about numbers, sizes, and characteristics of business firms supplying farmers. These will include firms concerned with fertilizer, feed, petroleum products, machinery and equipment, pesticides, and farm credit. The analysis will provide background for understanding trends in structure and farm-nonfarm relationships.

##### B. Economics of Farm Size and Numbers of Farms

A manuscript now being reviewed reexamines the role of family farms in an increasingly complex agricultural economy in which technological progress is altering traditional patterns of economic activity. The study shows that 3/4 of total agricultural production continues to take place on an increasing number of relatively small family-operated farms, rather than on large-scale factory-type farms. Also documented are the increasing quantities of nonfarm inputs associated with farm production, and the shifting of services and functions to nonfarm firms. The reduction in



labor input on farms is partially offset by increased employment in the processing and marketing of farm products.

Analysis of survey records taken for the study of economies of size of tobacco farms in North Carolina continues. The objectives of the study are to determine the size distribution and organization of management units in one economic subregion of the State, and to determine the effects of changes in the size of farms and levels of technology on efficiency and net operators' earnings. Detailed questionnaires obtained from 370 farmers in the spring of 1965 have now been tabulated. Additional records covering the same farms for 1955-57, 1958 and 1960, available from the cooperating North Carolina Station, also are being utilized. When the farms were compared for changes in organization between 1960 and 1964 it was found that the acreage of tobacco harvested had increased 30 percent, mostly the result of rental of additional tobacco acreage. The number of multiple unit farms on which a portion of the tobacco was operated by croppers has declined. A programming model will be developed using these data to indicate the effects of size of farm on operator's earnings and efficiency and advanced levels of technology. Short-run cost curves will be obtained to provide a basis for envelope cost curves to indicate economies of size.

Work continued on a study of economies of size of dairy farms in Minnesota. Short-run cost curves were developed for 3 alternative housing systems in addition to stanchion barn and loose housing. A broader look at alternative housing and milking technologies was made for 1-, 2-, 3- and 4-man farms. Short-run cost curves were estimated for 32 hypothetical farm situations, considering 2 alternative feeding systems with confinement housing. Additional programming was completed to determine the effects on unit costs and profitableness of changes in milk prices, the 1966 feed grain program, special crop rotation restrictions, a reservation price for the operator's labor, and higher wage rates for full-time hired labor. Results indicate that most of the economies of size are realized on 2-man dairy farms, although net returns to operator's labor and management was higher on 4-man farms because of the larger volume of output. The most efficient systems included loose housing combined with a double-4 herringbone milking parlor on 1- and 2-man farms and a double-8 herringbone on 3- and 4-man farms. Stanchion barns were most efficient for herd sizes of less than 20 cows. The lowest unit costs were obtained with loose housing and herd sizes of more than 20 cows.

Basic computations have been completed for least-cost organizations for corn and hog farms in Illinois. On cash-grain farms, lowest costs per dollar of gross income were obtained for 2-man and 3-man farms with 8-row equipment. However, an optimally organized 1-man farm with 8-row equipment gave nearly as low production costs. Such a 1-man farm would produce \$86,000 gross output on 850 acres, with a total investment of \$467,120. A 2-man farm would require 1,641 acres and a total investment of \$901,336. On hog farms, cost per dollar of gross income declined from \$0.71 for 1-man farms with 4-row equipment to a low of \$0.67 on 2-man farms with 6-row equipment. Total



investments on these 2 farms were \$167,242 on the 1-man farm and \$329,626 on the 2-man farm.

Analysis of economies of size for wheat-pea farms in Washington was nearly completed. Two sets of short- and long-run average cost curves were developed for: (1) farms participating in the farm programs, and (2) farms not participating in farm programs. Five short-run average cost curves were programmed for the program participants. These cost curves covered sizes ranging from 600 to 1,900 acres. There were 4 such curves for the non-participants which ranged in size from 800 to 1,900 acres. In each case the 1,600-acre farm was the optimum sized unit. The intermediate sizes were 800, 1,200, and 1,600 acres for program participants, and 1,200 and 1,600 acres for the non-participants. The gross income covered by these acreages ranged from about \$32,000 to approximately \$110,000. In every case these farms could have been operated by the owners with seasonal hired labor during the harvest season, and with hired labor during the fall planting season on the larger farms. A report is being prepared.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Vertical Coordination and Changing Structure

Hutton, Robert F. 1966. A simulation technique for making decisions in dairy farming. Agr. Econ. Rpt. 87. 143 pp.

Mighell, Ronald L. and Reiss, Franklin J. 1966. Factor leasing, procurement contracting, and production choices. Paper presented at conference on Production Economics in Agricultural Research sponsored by the University of Illinois, March 8-10, 1966. Published in the proceedings of the conference, pp. 151-170.

Scofield, W. H. 1966. Analyzing the structure of agribusiness relationships. Paper presented at American Farm Economics Association meetings, August. 10 pp.

B. Economics of Farm Size and Number of Farms

Davis, B. and Madden, J. Patrick. 1965. Theory and procedures for studying economies of size on irrigated cotton farms of the Texas High Plains. Tex. Agr. Expt. Sta. Misc. Pub. 780. 105 pp.

Hunter, E. C. and Madden, J. Patrick. 1966. Economies of size for specialized beef feedlots in Colorado. Agr. Econ. Rpt. 91. 49 pp.

Moore, Charles V. 1965. Economies associated with size, Fresno County cotton farms. Calif. Agr. Expt. Sta. Res. Rpt. 285. 49 pp.

Moore, Charles V. 1965. Income variability and farm size. Agr. Econ. Res. 12(4), pp. 108-115.

Moore, Charles V. and Snyder, J. H. 1965. Pump irrigation: cost increases in the Salinas Valley. Calif. Agr. 19(8), pp. 14-15.

Moore, Charles V. and Snyder, J. H. 1965. Irrigation pumping lifts in the San Joaquin Valley. Calif. Agr. 19(10), pp. 14-15.

RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

None reported.

#### AREA NO. 4. FARM CAPITAL, CREDIT, AND FINANCIAL CONDITION

Problem. Farm capital requirements, farm credit needs, and the financial condition of farmers are changing continuously. In the last several years total capital and credit usage have been rising sharply. These changes reflect in large part farmers' investments to make their farms more efficient and productive. New technologies in agriculture, accompanying the rapid pace of farm enlargement, require large investments and prices of farmland and many other inputs continue to rise. Increased output of some farm products, and shifts in production from one commodity to another, require additional capital. Continuous study is needed to keep abreast of the changing capital and credit requirements for various tenures, types, and economic classes of farms; to analyze how farmers accumulate the capital needed for their operations; and to determine the extent to which the institutions and other credit sources are providing the amounts, types, and terms of credit for farmers' changing needs. The developing debt situation requires continuous appraisal. Studies and analyses need to be developed for measuring the effects of changes in farm incomes and expenditures on credit usage and on the equity positions of farmers. Studies are needed for the guidance of farmers and lenders, and to aid policymakers and program administrators in appraising the effects of farm programs.

#### USDA AND COOPERATIVE PROGRAM

The work in this area comprises a long-term program of statistical and economic research in 3 principal areas: The balance sheet of agriculture and financial outlook; improvement of farm-mortgage credit facilities; and short-term credit and farm financial management.

In Washington, D. C., the work on the balance sheet of agriculture and financial outlook involves chiefly the assembly and analysis of statistical data and other information pertaining to the financial situation of farmers. The Division has become a clearing house for data on farm debts, to which the major lenders (or their supervisory authorities) report on their own loans to farmers and in return receive comprehensive information on the entire farm debt situation. In addition, the Division assembles data collected elsewhere in the Department and by some other agencies on farm assets and incomes and issues each year two analytical reports: (1) "The Balance Sheet of Agriculture," which measures and explains changes during the last year in the financial situation of agriculture; and (2) the "Agricultural Finance Outlook," which appraises current trends and provides estimates of the farm financial situation for the next year. These publications contain the only available comprehensive analyses of the farm financial situation. Continuing efforts are made both to improve the statistics used in the reports, and to provide more complete interpretation of the statistics.



As an aid in preparing the Agricultural Finance Outlook, surveys usually are made in the fall to determine the views of farmers, representatives of credit institutions, and other knowledgeable persons concerning the current farm financial situation and prospects for the coming year.

In the work on improvement of farm-mortgage credit facilities, data from all available sources are assembled and consolidated in Washington, D. C., to determine the amount and distribution of the farm-mortgage debt, the terms on which farm-mortgage credit is made available from the principal lenders, and trends in loan volume, repayments, refinancing, delinquencies, and foreclosures. Quarterly reports on the mortgage lending activities of the major life insurance companies, the Federal land banks, and the Farmers Home Administration are obtained and analyzed. At 5-year intervals, cooperative surveys with the Census are made to determine the amount of farm-mortgage debt held by individuals and other nonreporting lenders. In addition, the Census Sample Survey of Agriculture provides periodic data on the distribution of mortgage debt among the various types, sizes, and economic classes of farms. The data from these activities are used in preparing the Balance Sheet of Agriculture, and the Agricultural Finance Outlook. They also are used regularly by the National Agricultural Credit Committee, which meets 3 times each year to appraise the farm-mortgage situation. The interest charge on the farm-mortgage debt is one of the elements used in determining parity prices, and is a cost item in computing net farm income. Numerous requests for data on the farm-mortgage situation are received each year from legislators, farm organizations, farm journals, the State Experiment Stations, individuals, and others.

In the research on short-term credit and farm financial management, statistical work in Washington, D. C. is similar to that done on farm-mortgage credit, that is, serving as an assembly point and clearing house for information on the non-real-estate credit used in agriculture, and analyzing and interpreting the data. The data from this part of the work have uses similar to those on mortgage credit, except that they are not used in computing parity prices of agricultural products.

A continuing major project is the analysis of data from the periodic Census sample surveys which contain comprehensive information on a national scale on both short-term and mortgage debt. The surveys also obtained information on farm and nonfarm incomes of individual farmers, on the owned and rented value of farm real estate, on the tenure and type of farm, and on a number of other important items. Two publications were issued during the year, largely completing the work to be done on the 1960 survey. The second sample survey was conducted by the Census in late 1965 and early 1966.

Increasing capital requirements underscore the growing importance of financial management to individual farmers. Wise management is essential both to the beginning farmer and to the achievement of farm growth. Cooperative studies dealing with farm growth, its financing, and other aspects of farm financial management have been started at 4 locations during the year -- at



the Michigan, Florida, and Purdue University Experiment Stations and at Southern Illinois University.

Other cooperative work, continuing from the preceding year, includes the following: At Michigan, studies of savings, use of credit, and capital accumulation by Michigan farmers; at Missouri, studies of the financing of homes of rural nonfarm residents; and at Illinois, a study of changes in the value over time of fixed permanent investments made by farmers, especially when the investments are sold as part of the entire farm.

Federal scientific man-years devoted to the work totaled 6.3 divided as follows: Balance Sheet of Agriculture and Financial Outlook, 1.4; improvement of farm-mortgage credit facilities, 2.0; and short-term credit and farm financial management, 2.9.

#### PROGRAM OF STATE EXPERIMENT STATIONS

A total of 5.6 scientist man-years is devoted to this area of research.

#### PROGRESS -- USDA AND COOPERATIVE PROGRAM

##### A. The Balance Sheet of Agriculture and Financial Outlook

The value of farm assets reached \$256 billion at the beginning of 1966, up from \$238 billion a year earlier. The increase of 7.5 percent was about double the rate of the previous year. Total debts, including Commodity Credit Corporation loans, increased 10.7 percent. The equities of farmers and other owners of farm property increased \$13.8 billion or 6.9 percent. This dollar increase in equities was the largest since 1951-52.

As in other recent years, the major factor causing the rise in the value of assets was the increase in farm real estate prices. Sharp advances in market prices in the Corn Belt since last October, together with a continuation of past strong rates of increase in the Southeast, raised the total market value of farm real estate to \$171.1 billion (March 1, 1966), an increase of 7.3 percent above a year earlier. Improved farm incomes and the continued strong demand for farm enlargement were major factors in the rise of values. The value of livestock on farms rose \$3.1 billion or 22 percent from a year earlier. Machinery and motor vehicle inventory values increased \$1.8 billion or 6.8 percent.

Realized net income of farm operators at \$14.2 billion in 1965 was up 10 percent from a year earlier. Prices received by farmers averaged 5 percent higher. Prices of livestock and livestock products were up 11 percent, while prices of crops were down 3 percent. Improved prices resulted from reduced supplies of some commodities, especially pork, and from strong domestic and foreign demand. Cash receipts from marketings and direct Government payments to farmers both increased.

Farm debts, including CCC loans, increased \$3.9 billion during 1965 and totaled \$41.6 billion at the end of the year. Both real estate and non-real-estate debt increased by record amounts. Contributing to the large growth in debt was the optimism among farmers over income prospects. Farmers invested heavily in farm machinery, livestock, and other production goods. Sharply rising farm real estate prices, reflecting in part this greater farm optimism, also contributed to greater credit use. While farm debt increased \$3.9 billion, the value of farm assets increased \$17.9 billion. Although rising by a much smaller absolute amount, the rate of increase in debt was slightly faster than in asset values, and the debt/asset ratio rose to 16.3 percent from 15.8 percent a year earlier.

A report "Farmers and Their Debts . . . The Role of Credit In the Farm Economy" was published during the year. It was based on data from the 1960 Census Sample Survey of Agriculture. The report showed that indebted farmers generally had used credit (and rental of farmland) to help them establish themselves in farming, and to assist in enlarging and improving their operations and increasing their net incomes. It appeared that a large part of the total debt outstanding on the survey date was incurred to help finance the purchase of land, machinery, and the many other capital and current inputs. Farmers who were using credit in 1960 appeared to be more aggressive, more willing to take risks, and less willing to work with only the assets they owned outright, than were debt-free farmers. The most heavily (mortgage) indebted farmers owed 3-1/2 times as much land, and operated 6 times as much land, as they could have owned or operated without borrowing or leasing. A few farmers at that time (late 1960) had assumed large debt obligations. However, during the years since then, as indicated by periodic statistics from farm-mortgage lenders, the condition of the farm debt has remained strong with only minimal foreclosure or repayment difficulties.

#### B. Improvement of Farm-Mortgage Credit Facilities

Farm-mortgage debt continued another year of strong expansion with outstanding debt increasing \$2.3 billion or 12 percent in 1965 -- rising from \$18.9 billion to \$21.2 billion. This was the fifth consecutive year in which the dollar increase in outstanding debt exceeded that of the year before. Improved farm incomes in 1965, and good prospects for 1966, probably made farmers more willing to make longer-term investments in, and pay higher prices for, land and other capital items often purchased with mortgage funds. The Federal land banks increased their loan volume in 1965 more than any other lender. Loans made by individuals showed a less than average rise. Purposes of farm-mortgage loans changed little in 1965 from previous years. Interest rates on new loans were starting to rise by the end of the year.

A study of a sample of farm borrowers who refinanced their existing farm-mortgage loans and obtained additional funds from their present lender (a life insurance company or a Federal land bank) was made and partly analyzed during the year. The study was designed to show whether these



refinancing borrowers were getting in trouble with their debts. Information on about 700 borrowers was developed to show the annual progress these farmers were making in building up the value of their assets or paying their debts. Progress was calculated on a "real" basis -- in such a way as to omit the influence of strictly higher market prices of the farm real estate they owned. On this basis of measuring real financial progress, the group as a whole increased in net worth about 5 percent a year over the past several years. Only about 1 borrower in 10 showed declines in real net worth of more than 3 percent a year. Some 24 percent of the group were increasing their real net worths by 10 percent or more a year. Borrowing against rising farm real estate asset values thus appeared to be a frequent method used by farmers to help finance expansion of their operations.

A report was issued during the year analyzing the kinds of farm-mortgage loans made by the different farm-mortgage lenders, and the chief characteristics of the farmer-borrowers from each lender. There were 5 institutional lenders and 3 noninstitutional ones. The data were from the 1960 Census Sample Survey of Agriculture. Younger, less-experienced farm operators, with lower incomes and fewer assets, tended to obtain their mortgage financing from individuals rather than institutional sources. These farmers needed larger loans than most institutional lenders were willing to make. The great bulk of the individuals who extended credit to young farmers and to others were retiring farmers who made the loans in connection with the sale of their farms. Two-fifths of all mortgage borrowers under 35 years of age, and slightly over 1/5 of all mortgage borrowers, were using credit obtained from individual sellers of farms. The Farmers Home Administration also had sizable numbers of young operators among its borrowers. It appeared that many of the young operators, after they had succeeded in building up their assets and their incomes, would refinance their loans with one of the large institutional credit sources.

In Missouri a report on the financing of rural housing by the Farmers Home Administration (FHA) is being prepared for publication. In a study to be completed later, the characteristics of these FHA borrowers will be compared with borrowers who obtained financing from other sources. The FHA program was expanded recently to permit loan funds to be obtained from private investors with an FHA guarantee.

In cooperation with the Federal Reserve System and the Farm Credit Administration, a study is being made of the characteristics of the farm loans held by the major institutional lenders as of June 30, 1966. The Federal Reserve System is surveying the farm loans held by insured commercial banks, the Farm Credit Administration is securing data on the loans of the production credit associations and the Federal land banks, and the Farm Production Economics Division is securing data on farm-mortgage loans held by the leading life insurance companies, and on the operating loans and the farm-ownership loans made by the Farmers Home Administration. A comparable survey of the farm debt was made in 1956.



These studies of the farm debt by these major lender groups will show the changes in the characteristics of the farm debt over the last 10 years and will help to indicate the extent to which these institutions meet the credit needs of farmers.

Risk of loss was only one factor in the lack of adequate housing credit for non-farmers in rural areas as indicated by a study of the lending done through the now terminated Voluntary Home Mortgage Credit Program. Higher costs of operations and inadequate functioning of the banking and credit system were more important in restricting the amount and terms of rural home financing.

A preliminary report on the rural capital and credit market in Mineral County, West Virginia is being completed. This report indicates a very close relationship between the volume of loans made by banks in the county and the county's economic growth.

### C. Short-Term Credit and Farm Financial Management

Non-real-estate debt owed by farmers increased rapidly in 1965. Outstanding debt rose \$1.8 billion, nearly double the rise in the previous year. The improved farm income situation in 1965 probably was the most important factor in the rise. Farmers apparently expanded their buying by a greater amount than their incomes increased, thus requiring additional credit. Larger numbers of cattle were placed on feed during 1965 and at higher prices. Purchases of farm machinery rose nearly 10 percent further in 1965 from the previous record in 1964.

Outstanding loans of the production credit associations increased 13 percent during 1965, non-real-estate loans of the Farmers Home Administration 11 percent, and those of commercial banks 10 percent. The average size of loans of borrowers from the PCA's rose further during 1965, and over the past five years has increased by 45 percent. The size of farm-mortgage loan increased even more in the period, by 75 percent. These increases in the size of individual loans have been associated with the expansion in the size of farms, increased mechanization, and the stepped-up purchases of other inputs of goods and services.

A beginning was made during the year toward obtaining more current and comprehensive information on a portion of the non-real-estate loans held by the so-called "nonreporting creditors." This group includes merchants and dealers in farm supplies, individuals, and others who do not regularly report their holdings of farm loans. Statistics on their retail farm machinery loans were obtained from a number of large farm machinery credit corporations who provide credit to their retail dealers. The data from these firms indicated that their loans have been expanding somewhat more rapidly than total farm non-real-estate borrowings. These farm machinery loans were being repaid rapidly and losses were practically nonexistent. It is

planned to expand the coverage of farm machinery credit, and to broaden this work to include the financing of other farm production goods.

Further progress was made on the South Dakota farm credit study. During the last year many of the data obtained during the fieldwork phase were arranged and consolidated for purposes of analysis. Information was obtained on credit experience, financial statements, and personal traits for a sample of 100 Farmers Home Administration (FHA) and 100 production credit association borrowers in the State. Part of the data, dealing mostly with prior credit experience and purposes of the first loans from their present lender (FHA or PCA), were analyzed. A report was prepared for publication showing that 84 percent of the FHA borrowers and 78 percent of the PCA borrowers included in the sample, had used credit in their farm business prior to their first FHA or PCA loan. Of those with prior credit experience, 69 percent had used a commercial bank as their primary source of credit. Funds for operating expenses, refinancing existing debts, and purchasing livestock were, in that order, the most common purposes included in the first FHA or PCA loans to the 200 borrowers.

In Florida a study is underway to determine how beef production units are organized and operated and how the development of these units was and is financed. Beef cattle production is expanding in Florida, but little is known about its profitability, or about how operators have been able to build up their units to their present status.

A study has been started at Southern Illinois University aimed at appraising the influence of internal and external capital rationing on the abilities of farmers to build up their farms to approach optimum size and efficiency. Alternative financial plans will be developed involving varying amounts and proportions of credit, leasing, and provision of equity capital. Farmers and lenders will be asked the extent to which they would be willing to follow these plans.

In Michigan, Minnesota, and Indiana new studies have been initiated of the growth processes of farm firms.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Balance Sheet of Agriculture and Financial Outlook

Farm Production Economics Division. 1965. 1966 agricultural finance outlook. AFO-5. 34 pp.

Wall, Norman J., Garlock, Fred L., Allen, Philip T., Jones, Lawrence A., Scofield, William H., and Shapiro, Harvey. 1965. The balance sheet of agriculture, 1965. Agr. Inf. Bul. 290. 27 pp.

Wall, Norman J., Allen, Philip T., Evans, Carson D., Jones, Lawrence A., Reinsel, Robert D., Scofield, William H. 1966. The balance sheet of agriculture, 1966. Agr. Inf. Bul. 314. 30 pp.

B. Improvement of Farm-Mortgage Credit Facilities

Allen, Philip T. 1966. Farm real estate credit -- an analysis of borrowers and lenders. Agr. Econ. Rpt. 44 pp.

Farm Production Economics Division. 1965. Farm-mortgage debt. FMD-4. 7 pp.

Farm Production Economics Division. Farm-mortgage lending experience of 20 life insurance companies, the Federal land banks, and the Farmers Home Administration:

January 1966. FML-15. 11 pp.

July 1966. FML-16. 12 pp.

Jones, Lawrence A. 1966. Rural home financing through the Voluntary Home Mortgage Credit Program. ERS-270. 22 pp.

C. Short-Term Credit and Farm Financial Management

Christiansen, R. A., Staniforth, S. D., and Wolter, R. 1965. Effectiveness of development credit in facilitating rural adjustments. Univ. of Wis. Dept. of Agr. Econ. AG. EC. 45. 30 pp.

Curnutt, J. and Ferber, R. 1965. Financial stock-flow relationships among central Illinois farmers. Bur. of Econ. and Bus. Res., Univ. of Ill. 65 pp.

Farm Production Economics Division. 1965. 1965 agricultural finance review. Vol. 26. 75 pp.

Farm Production Economics Division. 1966. 1965 agricultural finance review. Vol. 26 Sup. 80 pp.



Farm Production Economics Division. 1966. 1966 agricultural finance review. Vol. 27. 94 pp.

Garlock, Fred L. 1966. Farmers and their debts -- the role of credit in the farm economy. Agr. Econ. Rpt. 93. 24 pp.

#### RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

Baker, C. B., and Tweeten, L. G. 1965. Financial requirements of the farm firm. Structural changes in commercial agriculture, CAED Rpt. 24, Iowa State Univ., pp. 27-52.

Collins, G. P. 1965. To what extent can farm capital needs be met by conventional credit? Some research indications. Okla. Agr. Expt. Sta. Agr. Econ. Paper AE 6518.

Collins, G. P. 1965. Acquiring land by contract for deed. Okla. Agr. Expt. Sta. Agr. Econ. Paper AE 6515.

South Dakota Agricultural Experiment Station. 1965. Farm credit. S. Dak. Farm and Home Res. 16(2).

South Dakota Agricultural Experiment Station. 1965. Farm management decisions -- a guide. S. Dak. Farm and Home Res. 16(3).

## AREA NO. 5. AGRICULTURAL RISKS AND INSURANCE

Problem. Risk bearing is a necessary and costly function of ownership and management in farming because of production hazards and price uncertainties. Expanded research in reducing agricultural risks should prove valuable to farmers in making management decisions, and to Government agencies and private insurance and financial institutions in adjusting their policies to meet farmers' needs.

Research in this field includes possible modifications of existing insurance, credit, and taxation policies, which impose excessive burdens when farm incomes are low. It also includes study of alternative means by which farmers can (1) reduce risks by the adoption of new financial and production practices, (2) shift part of the risk to insurance, financial, and Government institutions, or (3) most effectively combine these two approaches.

With rising farm-property valuations, more use of credit, inflation, and greater chance of personal injury, fatalities, and lawsuits (due to accidents arising from increased mechanization and more highway travel), more kinds and larger amounts of property, health and sickness, life, and liability insurance are required by today's farmers. There is considerable variation in premium costs among companies for identical coverages. The increased insurance coverages carried by farm operators require high premium outlays. Figures of from \$1,000 to \$1,500 are not uncommon. Priorities need to be established to aid farmers in allocating a given premium outlay according to need.

### USDA AND COOPERATIVE PROGRAM

A continuing program of applied and statistical research is carried on that involves compilation of data on farm accidents, fire losses, crop insurance, farm and personal insurance, social security, and farmers insurance companies. Analyses are made of the causes of farm fire losses and accidents, the impact of various types of insurance on agriculture, and the effect of social security programs on farm people.

Study is made of (1) the incidence of production risks, as reflected by yield variability and other factors, on the structure, functioning, and growth of farm firms, and (2) various methods of risk bearing that provide guides for decisions on feed and cash reserves, geographical dispersions of production, flexibility of organization, depreciation and tax management, and insurance.

Work is done in Washington, D. C. with informal cooperation of the Federal Crop Insurance Corporation, the Bureau of Old Age, Survivors, and Disability Insurance, insurance trade associations, farmers mutual insurance companies, State insurance commissioners, and State fire marshals. Work in Montana

is done with formal cooperation of the Experiment Station and with a Great Plains regional committee studying Federal Crop Insurance. Work on the relationship of risk-bearing to growth of firms in Kansas continues with formal cooperation of the Kansas Experiment Station. Study of the problems of risk and financial management involved in dairy farm adjustments has been initiated in Pennsylvania with formal cooperation of the Pennsylvania Experiment Station.

The program currently involves a total of 3.3 Federal scientific man-years: Improvement of farmers' mutual fire, windstorm, and crop-hail insurance company operations, 0.4 man-years; organized farm fire protection and estimation of annual farm fire losses, 0.2 man-years; casualty and life insurance (including social security) and accident prevention for farmers, 1.2 man-years; and analysis of risks and risk-bearing in agricultural production, 1.5 man-years.

#### PROGRAM OF STATE EXPERIMENT STATIONS

A total of 1.1 scientist man-years is devoted to this area of research.

#### PROGRESS -- USDA AND COOPERATIVE PROGRAM

##### A. Improvement of Farmers' Mutual Fire, Windstorm, and Crop-Hail Insurance Company Operations

Farmers in the Corn Belt received more than \$25 million in hail insurance indemnities for damage to growing crops in 1965. Most of the payments were made in Illinois and Iowa. Crop-hail insurance coverage reached a record \$3.0 billion for the United States in that year.

A study of farmers' mutual insurance companies suggests a need for increased use of deductible fire insurance policies on farm properties. Farm mutuals had an estimated \$41.1 billion of fire and lightning insurance in force at the end of 1965 -- about 4/5 of it on farm property. Companies with \$100 million or more of fire insurance in force increased their insurance volume about 5 percent in 1965; those with less than \$10 million of fire insurance averaged a decrease of 0.5 percent.

Severe windstorms did extensive damage to insured property in sections of the Midwest during the spring of 1965. These losses brought financial difficulties to some smaller companies.

##### B. Organized Farm Fire Protection and Estimation of Annual Fire Losses

Farm fire losses estimated at \$187 million for 1965 were down from the record high of \$193 million in 1964. Farmers' mutual insurance company data indicate that less than 2 percent of all farm fires involved losses of \$5,000 or more, but these large fires accounted for 57 percent of the insurance losses



paid. About 58 percent of all losses paid were less than \$50 each and amounted to only 3 percent of the total loss.

C. Casualty and Life Insurance (Including Social Security) and Accident Prevention of Farmers

An analysis of farm Social Security tax returns showed that the number of individuals reporting self-employment earnings from farming decreased 14 percent between 1959 and 1963. However, increased numbers reported net earnings of \$4,000 or more. Fewer returns were filed each year in the \$2,000-or-less class.

The Corn Belt, Northern Plains, and Mountain Regions accounted for about 45 percent of the Schedule F tax returns. The Pacific Region had the highest percentage reporting net earnings of \$4,000 or more in 1963 -- 38 percent. In the Appalachian region 75 percent reported less than \$2,000 and only 7 percent reported \$4,000 or more. The number of farm tax returns declined 20 percent in the Northeast.

Study of a 1-percent sample of farm tax returns showed that the number of returns increased until 1959, remained fairly constant for a few years, and appeared to be declining by 1963. In 1962, sole proprietors reported nearly 4/5 of all farm receipts; partnership and corporations each reported slightly more than 1/10. More than one million -- 31 percent -- of the sole proprietors reported farm losses in 1962. Sole proprietor receipts and profits rose about 11 percent and 16 percent, respectively, between 1960 and 1962. Nonfarm income was important, particularly to those with low net farm profits or farm losses. Wages and salaries were the most important nonfarm income source.

An analysis of fatal accidents on farms shows that those involving machinery, especially tractors, have increased relative to other causes in recent years. They accounted for 38.6 percent of all accidental farm deaths in 1963-64. About 3 of 10 in the farm labor force received nonfatal injuries in 1961-63 involving medical attention or a day of restricted activity. The economic cost of farm accidents in increased expenses and lost income is substantial.

D. Analysis of Risks and Risk-Bearing in Agricultural Production

County data on wheat yields for 1926-62 in 9 Great Plains States showed that year-to-year production risks were greatest in the Panhandles of Texas and Oklahoma, and in Southwestern Kansas and Southeastern Colorado. Variability of yields, however, was generally less in those sections in the last half of the period than in the earlier half.

An evaluation of the risk protection features of the current wheat and feed grain programs in Montana indicates that payments made in event of complete crop failure would more than cover cash farm expenses. If Federal all-risk crop insurance was also taken, the combined payments would cover cash

operating costs, depreciation charges, and family living expenses for the 2 hypothetical 1,200-acre cash-grain farms studied.

An initial regression analysis of farm management association data did not produce significant results in explaining the growth of Kansas farm firms. Several changes in the variables used in the regression models are now being considered. Information not available in the association records, such as nonfarm income, inheritances, family illness, etc., may be needed to explain farm business growth in some cases.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Improvement of Farmers' Mutual Fire, Windstorm, and Crop-Hail Insurance Company Operations

Perkinson, Leon B. 1965. Crop-hail insurance in the United States. ERS-249. 18 pp.

B. Organized Farm Fire Protection and Estimates of Annual Farm Fire Losses

Reinsel, Edward I. 1966. Farm fire losses and farm mutual company operations. Farm Production Economics Division. Unnumbered. Mimeographed. 2 pp.

C. Casualty and Life Insurance (Including Social Security) and Accident Prevention for Farmers

Jones, Lawrence A. and Reinsel, Edward I. 1965. Social Security Amendments of 1965 -- importance to farm and rural people. ERS-257. 18 pp.

Jones, Lawrence A. 1966. Farm accidents. ERS-293. 8 pp.

Jones, Lawrence A. 1966. Insurance. 1965 Yearbook of Agriculture, pp. 165-168.

Reinsel, Edward I. 1966. An analysis of farm social security tax returns. Agr. Fin. Rev. 27, pp. 37-47.

D. Analysis of Risks and Risk-Bearing in Agricultural Production

Larson, Donald K. and Thompson, Layton S. 1966. Variability of wheat yields in the Great Plains. ERS-287. 38 pp.

Larson, Donald K. 1966. Evaluation of crop risk-protection benefits of wheat and feed grain programs. Agr. Fin. Rev. 27, pp. 20-25.

RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

None reported.



## AREA NO. 6. FARMLAND VALUES AND VALUATION

Problem. Farmland and buildings comprise the largest single productive asset in agriculture, with a current market value of nearly \$175 billion, or two-thirds of all agricultural assets. Trends in market values of this asset, and reasons for such changes, are of continuing interest to land owners, prospective purchasers, public and private credit institutions, industries serving agriculture, local governmental units, and Federal agencies. Public and commercial lenders need current information regarding both current and prospective trends in land prices as a guide for formulating and modifying their appraisal and credit policies. Farm programs often have widespread and pervasive effects on land values and changes in programs need to be continually evaluated regarding such effects.

Market prices of farm real estate have risen almost without interruption since the early 1940's. During the 1950's, this rise was viewed by many as a paradox because of the apparent lack of support from farm income. New economic forces emerged which appeared to obviate the traditional historical relationship between farm earnings and land prices. Some of these could be found within the agricultural sector, such as the rapid adoption of new production technology and the expansion of farm operating units, and others were clearly attributable to developments in the nonfarm economy. Forces outside the farm firm have increasingly become partial determinants of land prices over wider geographic areas as metropolitan areas expand and as improved transportation facilities expose larger areas to the impacts of population growth. Present and potential demands for land as space, rather than solely as a productive resource for agricultural uses, need to be more adequately recognized if useful and realistic projections are to be made of future trends in land prices.

### USDA AND COOPERATIVE PROGRAM

The work involves a continuing program of applied research designed to obtain current information on various aspects of the farm real estate market at the State and national levels. Statistical series are developed and maintained to measure periodically changes in market prices of farm real estate, rates of farm transfers by various methods, sources and terms of credit used to finance land transfer, and sources of the demand for, and supply of, farmlands that come on the market. Two surveys are directed annually to farm real estate brokers and other informed people to obtain such basic information. These data, together with the estimates of market values obtained from USDA crop reporters, are summarized and analyzed in periodic reports issued twice a year. Increased attention has been given in recent years to the rural nonfarm sector of the land market, including sales of farms for nonfarm uses and prices of land for various recreational uses.

The current market developments phase of the research program outlined above is supplemented by special studies on selected aspects of the rural land market such as farm building valuation, determination of a cost basis for farms, and alternative measures of land earnings. Liaison is maintained with Federal and private credit agencies and with private farm real estate sales and management organizations, by which survey and research results are made available to them in exchange for the information they provide.

The Washington-based research program is supplemented from time to time with cooperative studies with State Experiment Stations in which specific facets of the farm real estate market are studied in greater depth than is possible at the national level. Four such studies are currently in progress. Three of these (South Carolina, Louisiana and California) will determine prevailing market prices being paid for cotton lands and the factors associated with the variations found in land prices in the study areas. These three studies also will provide a basis for establishing alternative methods for setting an annual land cost for use in the Division's study of costs of producing cotton. The fourth study, in cooperation with the Nebraska Station, will obtain current information on buyers and sellers, financing, and the complementary relationships between the land purchased and the size and organization of the farm operated by the buyer before and after purchase.

Annual estimates of gross and net rents paid for rented land represent another continuing research project on the national level. Such estimates are needed in calculating net income of farm operators by USDA and are incorporated in the national income accounts of the Department of Commerce. Rents also provide an independent measure of rates of return to farmland and are a useful analytical tool in the continuing study of land prices.

About 3.5 Federal scientific man-years are currently devoted to all phases of the research program in farmland values and valuation. Of this total, about 1.5 man-years are allocated to the current market developments phase of work and 1.7 man-years to analysis of factors affecting land values and transfers. Lack of personnel limited work on farm real estate rentals to 0.3 man-years.

#### PROGRAM OF STATE EXPERIMENT STATIONS

A total of 5.2 scientist man-years is devoted to this area of research.

#### PROGRESS -- USDA AND COOPERATIVE PROGRAM

##### A. Current Developments in the Farm Real Estate Market

Market prices of farm real estate advanced sharply in the Corn Belt in the fall and early spring of 1965-66. Indiana led all States with an increase of 15 percent in the year ended March 1, 1966, followed by Illinois and Iowa at 12 percent. Increases were about the same as in previous years elsewhere in the country and the national index for March 1, 1966, advanced to



150 (1957-59 = 100). This was 8 percent above a year earlier and 3 percent higher than November 1, 1965. These increases raised the total market value of farm real estate on March 1, 1966 to \$171 billion, up \$11.7 billion from the previous year. This was equivalent to \$157 per acre and \$57,100 per farm.

Demand and supply indicators during late 1965 and early 1966 showed an increase in the number of people looking for farms and a decline in the number of farms offered for sale. Some reduction was apparent in the available supply of credit, and interest rates turned up slightly.

Voluntary transfers of farm real estate were at the rate of 31.1 per 1,000 farms in the year ended March 1, 1966, 8 percent above the previous year and the highest rate since 1959. The rate of foreclosure at 0.9 per 1,000 was at a new low. Two-thirds of all farmland buyers during the year ended March 1965 were active farmers -- either owner-operators or tenants. More than half of all purchases were for enlargement of the buyers' farms, more than double the proportion a decade earlier. Three-fourths of the sales in each of the past 3 years involved credit. The amount of debt incurred in relation to the purchase price has trended upward and reached 72 percent in 1965. Sellers financed 38 percent of all credit sales, mostly by installment land contracts. Among commercial lenders, commercial banks were the most frequent source of funds, followed by insurance companies and the Federal Land Banks.

#### B. Analysis of Factors Affecting Land Values and Transfers

Several special questions were included in the October 1965 farm real estate market survey to determine the relative importance of various nonagricultural demands for land and the effects of such demand on market prices of farmlands. Nationally, about 1/3 of the reporters thought that market prices for farmlands were not affected by nonfarm uses for land. The remaining 2/3 noted one or more nonfarm uses which were contributing to market prices in excess of agricultural value. Residential demand for land was cited most frequently, followed by the acquisition of land for future development. Demand for land for highways and public works appeared to be relatively important in the Appalachian States, whereas private and public recreational demands for land were cited frequently in the Northeast and Lake States.

A rough approximation of the effects of various types of nonfarm demand for land on market prices was obtained by comparing prices reported by those who observed little or no such demand in their localities with the prices reported by those who thought market prices were above agricultural values. Nationally, market prices were estimated to exceed agricultural values by 17 percent. The difference was less than 10 percent in the Corn Belt, Northern Plains and Southern Plains, but exceeded 25 percent in the Appalachian and Pacific regions.



Imputed residual returns to farmland in 1965 increased sharply over 1964 as a result of the 20-percent gain in total net income to the agricultural industry. After allowing for a return to operators' labor and management, and a return on non-real-estate capital, the net returns to land were estimated at 5.0 percent in 1965, compared with 3.0 percent in 1964 and an annual average of 3.5 percent for 1960-64. The net returns to land and service buildings (excluding operators' dwellings) represented about 35 percent of the total net returns to all resources used in agricultural production in 1965.

Field work and analysis of sales data from the Delta region cotton land cost study are currently underway. About 1,000 land transfers occurring in 1964 and the first half of 1965 have been obtained from Delta cotton counties in Louisiana, Mississippi and Arkansas. A mail questionnaire was sent to buyers to obtain additional information on land characteristics and other details concerning the transaction. A preliminary analysis of these data using multiple regression to isolate the various components of value was only partially successful. Sales prices were found to range between \$75 and \$100 per acre for woodland, \$185 to \$225 an acre for open land, and \$300 to \$400 an acre for land with cotton allotments. Additional data are being collected by field interviews of a sample of land buyers in order to explain more of the variation that exists in land prices and to provide a better basis for analyzing the land market in this region.

A similar study in 2 cotton-producing counties in the South Carolina Coastal Plain has progressed to the field interview stage. Acreage and price data for all bonafide sales in Calhoun and Clarendon Counties were obtained from county records and supplemented with land use and acreage allotment data from ASCS and SCS records. A preliminary analysis of these data using multiple linear regression yielded inconclusive results. A field schedule has been developed to obtain additional information regarding buyers and sellers, financing, prevailing rental arrangements in the area, and characteristics of the buyers' farming operations before and after the purchase of additional land. The California study is currently at about the same stage of progress.

Although the Nebraska study was not initiated until mid-August, field work has been completed in 5 counties and 200 schedules obtained from buyers have been edited. Plans are to summarize these data in the fall and winter of 1966-67 and prepare a report for publication. In the 2 areas in which 60 buyers were interviewed in 1966, buyers who purchased land for farm enlargement will be interviewed again in the summer of 1967 to determine the impact of additional land on the organization of their farms, the additional costs and returns realized, and the marginal returns from the additional land.

### C. Agricultural Rents

Gross rents were estimated at \$4.0 billion in 1965, up from \$3.7 billion in 1964. Both cash and share rents advanced, but somewhat less than landlords' expenses, resulting in an increase of 9 percent in net rental returns.

A special set of rent estimates was developed for the period 1959-65 in connection with the Department's study of income parity to provide a measure of an opportunity cost for the investment in farm real estate. These new estimates were limited to commercial tenants renting on a crop-share basis, and cash tenants, utilizing data from the 1959 census and special survey materials. Net rental returns were found to have increased almost steadily over the 1959-65 period, partly as a result of the increase in Government payments received by landlords. Amounting to less than 2 percent of net rents in 1959-60, they accounted for 13 percent of net rents in 1965. As a percentage return on market prices of share-rented land, net rents held relatively constant for the period studied, ranging from a low of 5.5 percent in 1959 to 6.4 percent in 1961-63. Net returns under cash rental arrangements were 1.0 to 1.5 percent lower than for share-rented farms in most years.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Current Developments in the Farm Real Estate Market

Economic Research Service. 1966. Farm real estate market developments. CD-68. 44 pp.

B. Analysis of Factors Affecting Land Values and Transfers

Donner, Peter and Hock, Kenneth. 1965. Adjustments on the farm and transition out of farming in two Wisconsin dairy areas, 1950-1960. Wis. Agr. Expt. Sta. Res. Bul. 264. 16 pp.

C. Agricultural Rents

None

RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

Andrews, Boyd and Wooten, A. B. 1965. What's happening in the Texas farm and ranch land market. Tex. Expt. Sta. and Tex. Agr. Ext. Serv. Bul. B-1042.

Factors in the farmland market. 1965. Report of a seminar held in Chicago in November 1964. Ill. Agr. Expt. Sta. Special Pub. 8. 47 pp.

Murray, Ray A. and Reinsel, Robert D. 1965. The transfer of farm and open country real estate in six Maryland counties, 1962. Md. Agr. Expt. Sta. Misc. Pub. 557.

Quenemoen, M. E. and Thompson, Layton S. 1965. How to estimate land value. Mont. Ext. Serv. Bul. 327.



## AREA NO. 7. ECONOMICS OF FARM PRACTICES AND TECHNOLOGY

Problem. New and rapidly changing technology is having profound effects on agriculture. Ever-changing conditions of production brought about by new machines, new-type structures and related equipment, and improved methods of crop and livestock production require continual economic study to provide farmers, policymakers, and industries serving agriculture with guidelines for decision in a changing economic environment. Such studies need to measure and keep abreast of major changes in farming technology and must appraise the implications of these changes for the future. These studies should include analyses to provide information needed by farmers in different situations as they adjust to changing conditions of technology, prices, and costs. They should also include analyses aimed at guiding policymakers and program administrators as well as at helping industry to meet better the needs of farmers.

### USDA AND COOPERATIVE PROGRAM

This is primarily applied research, consisting of a continuing program of collection and analysis of data bearing on national situations and of the study of certain important innovations in farm practices and technology. Included is the development of aggregative measures of the effects of technological changes on farm output, costs, and income.

More specifically, the work involves the collection of pertinent data and the economic analysis of developments in farm mechanization and structures; in the use and effects of fertilizer, pesticides, and related crop practices; and in the production and utilization of livestock feed. These activities center in Washington, D. C. and consist mainly of broad national studies dealing with both the supply aspects and the demand aspects. They usually involve at least informal cooperation of other USDA agencies, particularly the Statistical Reporting Service and the natural science and engineering groups dealing with mechanization, crop practices, and livestock feeding. Research results are normally presented in aggregative terms for areas, States, or regions, along with supporting data such as input-output ratios. Intensive studies of narrower scope are made occasionally in selected areas to obtain information to supplement national and regional data from other sources. Such studies are usually in cooperation with State Experiment Stations. Currently, the cooperating Stations are Iowa, Michigan, and Nebraska.

The manpower currently devoted to this program is estimated at 7.6 Federal scientific man-years: 2.6 on economics of pesticide use in agriculture, 1.6 on economics of feed use and feed livestock relationships, 0.8 on economics of farm mechanization and associated techniques, 0.9 on inventory and analysis of production practices (national), 1.1 on economics of fertilizer use and crop technology, and 0.6 on economics of farm structures and materials handling including a now-completed research contract with Iowa State University for a survey and certain analyses of farm service buildings.

## PROGRAM OF STATE EXPERIMENT STATIONS

No scientist man-years reported.

### PROGRESS -- USDA AND COOPERATIVE PROGRAM

#### A. Economics of Pesticide Use in Agriculture

The recently initiated research on the economics of pesticide use in agriculture is divided into three major phases: (a) A nationwide survey of farmers to obtain basic data on costs and practices used to control plant and animal pests, (b) economic analyses of selected alternative methods of pest control on farms with emphasis on innovations to control pests, and (c) analyses of the aggregate economic implications of alternative methods of pest control for agriculture as a whole.

The nationwide survey of pesticide uses conducted in 1965 is currently being tabulated. In addition to the pesticide information related to use and pest control practices, supplementary data relate to farm characteristics, crop and livestock production, labor use, and net worth. About 10,900 questionnaires are being tabulated from farmers in 417 counties of 47 States. Hawaii and Alaska were not included in the survey and the probability sample did not result in any farms being drawn in Rhode Island. In addition, limited information on pesticide use and farm characteristics was enumerated on about 23,000 nonqualifying farms. Nonqualifying farms were considered to be those with less than \$2,500 of gross income from agriculture in 12 Southeastern States and less than \$5,000 of gross income in all other States.

Preliminary estimates from the survey are presented in the accompanying table. In 1964, 94 percent of all farmers surveyed used chemicals for controlling pests of crops and livestock. Nearly 3/4 of the farmers interviewed used pesticides on crops. The highest proportion of farmers using pesticides was in the Appalachian States where many farmers raise tobacco or cotton. Ninety-five percent or more of the tobacco, vegetable, and fruit and nut farms used pesticides on crops. However, in several regions, such as the Mountain States and the Southern Plains, only about half of the farmers treated crops mainly because of the large amount of pasture and the kind of crops grown. Fewer farms had substantial livestock enterprises as compared to crops, and this is reflected in a lower percentage of farmers treating livestock with pesticides. However, about 90 percent of the dairy farmers and 75 percent of the livestock farmers treated livestock.

Preliminary estimates also indicate that total farm expenditures for pesticides in 1964 were about \$475 million. This includes about \$50 million for the smaller farms not included in the survey. Of the total expenditures, about 85 percent was for crop pesticides, growth regulators, and harvesting aids. These estimates do not include expenditures for seed treatment or treating stored crops and storage buildings.

Percent of farms reporting the use of pesticides, by regions, and the United States, 1964 1/

Region	PESTICIDES USED FOR:			
	Crop treatment	Livestock and poultry treatment	Other purposes <u>2/</u>	All purposes <u>3/</u>
	<u>percent</u>			
Northeast-----	63	74	44	96
Lake States-----	70	80	53	98
Corn Belt-----	79	71	71	97
Northern Plains----	71	71	56	96
Appalachian-----	88	49	42	97
Southeast-----	69	30	29	82
Delta-----	83	43	68	95
Southern Plains----	45	57	35	84
Mountain-----	54	56	43	87
Pacific-----	68	37	47	94
United States----	72	62	51	94

1/ Farms with sales of agricultural products of \$5,000 or more in all areas of the United States except the South. In the South (Appalachian, Southeast, and Delta States) farms with sales of over \$2,500 are included.

2/ Expenditures for use on land other than cropland and for rodent control. Does not include expenditures for seed treatment, or treating stored crops and storage buildings.

3/ Does not include expenditures for seed treatment, or treating stored crops and storage buildings.



Two studies in cooperation with the Michigan and Nebraska State Experiment Stations are currently underway that relate to the economics of pest control methods. These studies are in their early stages. The work in Michigan will build on research done earlier in Illinois, where it was concluded that herbicides may result in more effective control of grass weeds than is possible with cultivation, and thus increase yields. But if the level of weed control is similar, the methods by which weeds are controlled have no effect on yield. Further, if grass weeds can be controlled satisfactorily with normal tillage practices, the use of herbicides cannot be justified on a costs and returns basis unless the opportunity cost of labor is high.

In Nebraska, a survey of methods of growing the 2 most important crops, corn and grain sorghum, showed that about 55 percent of the corn and 4 percent of the grain sorghum were treated for insects. The insecticides used on corn were primarily for controlling the corn rootworm. Organic phosphates are replacing chlorinated hydrocarbons for the control of the corn rootworm because it has developed resistance to the hydrocarbons. Pesticides for controlling weeds are used on about 25 percent of the corn and 37 percent of the sorghum acreage. The use of preemergence treatment is more important for corn than for sorghum.

#### B. Economics of Feed Use and Feed-Livestock Relationships

Continuing research is carried on at the national level to determine the effects on feeding efficiency of current and emerging technologies in livestock production and its supply industries. Annual data are prepared to show current feeding rates for all types and classes of livestock. Significant trends are identified in the feed-livestock industry with historical indexes for each species and class of livestock and each feedstuff. Animal unit and feed unit series are used to ascertain the position of each class of livestock and its corresponding feedstuffs in relation to aggregate production and disappearance of livestock and feeds.

A study to determine average feeding rates and total feed consumption of harvested feedstuffs for various kinds of livestock in each of the 48 contiguous States was completed. The resulting manuscript has been cleared for publication. This study shows that levels of feed consumption are higher in recent years although annual increases have tapered off. Comparisons of aggregate consumption of various feedstuffs show the following increases for the feeding year 1959-60 over the feeding year 1949-50: silage, 82 percent; hay, 27 percent; other harvested roughages, 72 percent; and concentrates, including grains, 21 percent. Actual tonnage of all harvested feedstuffs consumed was up 96 million tons -- from 272 million in 1949-50 to 367 million in 1959-60. Hogs continue to be the largest consumer of concentrates followed by poultry. Preliminary estimates for the 1964-65 feeding year show that beef cattle consumed more concentrates than dairy cattle for the first time on record.

A further study, similar to the one on feeding rates of harvested feedstuffs described above, to determine the relative use of all feeds, including pasture, is being completed. This study is unique in that the pasture contribution to total feed consumption is assigned a quantitative measure by individual States and geographic regions.

A major research effort is underway to determine the economic impact of emerging innovations in the feed-livestock industry. The initial phase of this study concerns the consumption of synthetic urea by beef cattle and dairy cattle. In cooperation with SRS, cattle feeders in 37 States were surveyed to determine their use of urea. A similar survey was made of dairy farmers in 48 States. From these 2 surveys, approximately 15,000 useable detailed questionnaires were obtained. In addition, individual feed manufacturers as well as a national trade association have cooperated by providing additional information on the production and use of urea as feed. Early findings in this study suggest that considerably more synthetic urea is being fed than had previously been assumed.

#### C. Economics of Farm Mechanization and Associated Techniques

No report.

#### D. Inventory of Production Practices

Estimates of fertilizer use by crops are being developed for the year 1964. These are geared to census data and to similar USDA fertilizer distribution reports for 1954 and 1959. Progress is related to receipt of preliminary census releases. Census data are received by the national leaders, processed along with other information, and sent to State work groups. This step has been accomplished for 32 States. Estimates of fertilizer use by crops have been received from 8 States.

A national survey of methods of handling forage in 1963 shows that the number of silos on farms increased 48 percent from 1950 to 1963, reaching a total of about 1 million in the latter year. Upright silos accounted for 68 percent of the total, trench silos for 25 percent, and other types for 7 percent. Eighty percent of the total number of silos was filled in 1963. The average capacity of all silos in 1963 was 160 tons and the average capacity of all silos that were used was 164 tons, with an average of 140 tons stored in each. In total, over 112 million tons of silage was stored in 1963 as compared to 46 million tons annually about 10 years earlier. Seventy-three percent of the silage produced in 1963 was corn, 11 percent was sorghum, 9 percent was grass, and 7 percent was miscellaneous crops and by-products. Nearly 3/4 of the silage hauled was moved from the field in wagons or trailers and 1/4 was moved in trucks. Sixty percent of the tonnage hauled was unloaded with power equipment.

A national survey of custom and exchange work and machine rental in 1964 showed that of 153 million acres that were combined, 28 percent (43 million



acres) was harvested with custom or exchange machines. Custom harvesting of silage represented 27 percent of the acreage harvested for silage. About 28 percent of the acreage of hay that was baled was custom baled. Custom or exchange work accounted for 57 percent of the tonnage of feed ground. Hauling of farm products with custom or exchange trucks amounted to 52 percent of the tonnage moved off the farms in 1964. Other custom and exchange operations were field shelling of corn, 34 percent of the acreage shelled; artificial drying of corn, 24 percent of the quantity dried; and tilling and planting of crops ranged from 2 percent of the acreage for disking-harrowing to 4 percent each for plowing and planting. The 4 machines most often rented or leased were tractors, trucks, fertilizer distributors, and sprayers.

Preliminary results of a 48 State survey on corn growing practices in 1965 show that of the 67 million acres of corn planted for all purposes, about 90 percent was plowed and disked or harrowed before planting. However, some land that was plowed was planted without disking or harrowing. Also, some of the land was planted after disking or harrowing without plowing. About 50 percent of the corn acreage received chemical treatment for the control of weeds. When corn was treated for weed control it was cultivated an average of 1.9 times. This compares with 2.4 times when it did not receive treatment with herbicides. Treatment for the control of insects was used on 30 percent of the corn acreage in 1965. Additional information and State and regional data are being processed.

#### E. Economics of Fertilizer Use and Crop Technology

A pilot study with firm solutions at two different levels of technology, and with projections of numbers of farms at different income levels, was used to project aggregate effects of changing farm technology by 1980 for a 20-county part of the Georgia Piedmont. For the study area, which had 4,266 farms in 1959, the projected number of commercial farms in 1980 was 2,730. Separate projections were made by economic classes and type of farm. A minimum cost model was used to obtain optimum solutions for different levels of income. At the individual farm level, the maximum income attainable for a 1-man crop-beef farm under present technology was \$3,303; for improved technology, \$6,525. For the 2-man farm the comparable figures were \$5,872 and \$12,210. The optimum organization for a net operator income of \$5,000 on a crop-beef farm called for a capital investment of \$33,372 under present technology; \$17,503 under improved technology.

In the aggregate, alternative solutions applied to projected numbers of farms of different income classes indicated different acreage and output totals depending on the type of farm and production situation. Some solutions included woodland activities, but the following comparisons are from solutions without such activities. For 2,730 crop-beef farms at present technology with no corn sold, gross sales would amount to nearly \$60 million, compared with \$37 million from 4,266 commercial farms in 1959. Land in farms would amount to 574,000 acres compared with 1,485,000 in 1959. Under improved technology, land in farms would be reduced to 348 million acres, with gross



sales of about \$61 million. Aggregate farm expenditures would shift substantially. For example, projected expenditures for fertilizer and lime at present technology would be about \$11 million compared with \$8 million in 1980 under improved technology, and \$3.4 million in 1959. The lower projected expenditure for these items under improved technology reflects substitution of cotton for some of the Coastal Bermuda grass rotation, a rotation that requires large applications of fertilizer. For example, projected corn production under present technology would be more than 3 times that for improved technology, and projected cotton would come under improved technology but not under present. Also, the acreage required for the projected number of farms at different income levels is smaller under improved technology.

#### F. Economics of Farm Structures and Materials Handling

Research on the national aggregate investment expenditure for farm buildings was completed and the results are being prepared for cooperative publication in Iowa State Research Bulletin 545 "Aggregate Investment Demand for Farm Buildings" by John T. Scott, Jr. and Earl Heady. The work was conducted under contract with Iowa State University. The major results were summarized in last year's progress report.

Additional research on farm buildings has been largely completed, based on a survey of a sample of farms in 20 counties of north central Iowa. The results lend support to the national aggregative study and also provide considerable information not previously available on farm buildings, including a complete inventory of buildings on the surveyed farms by age, type, use, and other characteristics. Regression analysis of the farm survey data shows that important factors affecting the investment demand for farm buildings include farm income, farm size, and operator's net worth. The survey results also suggest that farm consolidation in a mature farming area such as north central Iowa may have little effect in the short-run on the demand for building investments. In the longer-run, however, due to location and obsolescence of buildings obtained in consolidation, there may be pressure for investment in new buildings. Expansion of the survey sample leads to the conclusion that during the period 1964-68 in the 20-county area, total expenditures for new buildings and for remodeling are likely to be \$87 million, about the same as for 1959-63, but with a changing relationship between remodeling and new construction. Remodeling would increase slightly, offset by a decrease in expenditures for new buildings.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Economics of Pesticide Use in Agriculture

Drew, John S. and Van Arsdall, Roy N. 1966. The economics of preemergence herbicides for controlling grass weeds in corn production. Ill. Agr. Econ. 6(2), pp. 25-30.

B. Economics of Feed Use and Feed-Livestock Relationships

None.

C. Economics of Farm Mechanization and Associated Techniques

None.

D. Inventory of Production Practices

Strickler, Paul E., Smith, Helen V., and Walther, Wilbert H. 1966. Uses of agricultural machinery in 1964. Stat. Bul. No. 377. 17 pp.

E. Economics of Fertilizer Use and Crop Technology

Ibach, Donald B. 1966. Fertilizer use in the United States -- its economic position and outlook. Agr. Econ. Rpt. No. 92. 26 pp.

F. Economics of Farm Structures and Materials Handling

None.

RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

None reported.

## AREA NO. 8. FARM COSTS AND RETURNS

Problem. In this period of rapid change in American agriculture, it is important to have comprehensive, reliable, current, and historical data on representative or typical farms in major commercial farming areas of the United States. Physical and economic data needed include: Farm size, land use, livestock numbers, production, investment, prices received and quantities sold, prices paid and quantities purchased, and net returns. Such information is essential for intelligent policy and operating decisions by the agencies and industries serving agriculture and by farmers themselves.

### USDA AND COOPERATIVE PROGRAM

Costs and returns by major types of farms is a continuing study of operations of typical or representative commercial farms to determine changes in size of farm, organization, investment, productivity, receipts, expenses, net farm income, physical inputs, farm output, prices received for products sold, and prices paid for goods and services used in production. Budgets are prepared annually to provide current information. Estimates for earlier years are revised as new information becomes available. Analyses are continually underway to show the effects of economic and technological changes on land, labor and capital requirements, production, production efficiency, and incomes of typical or representative commercial farms. Nearly all the work is done in Washington with informal cooperation with States where the studies are located. Formal cooperation is maintained with the Iowa, Kentucky, Maine, and Tennessee Experiment Stations and is being developed with others.

A total of 7.5 Federal scientific man-years were devoted to all costs and returns work.

### PROGRAM OF STATE EXPERIMENT STATIONS

A total of 37.0 scientist man-years is devoted to this area of research.

### PROGRESS -- USDA AND COOPERATIVE PROGRAM

#### A. Costs and Returns by Major Types of Farms

Estimates for 1965 bring up to date the continuing series on costs and returns of typical commercial farms in the major producing areas of the United States. The report for 1965 covered 42 types of farms. Study of the results of an enumerative field survey and questionnaires of the U. S. Census of Agriculture indicated minor revisions should be made in the cash grain farm series in the Corn Belt. These were made. Total size of farm was not substantially changed, but there was a sizable increase in the



acres of crops harvested, particularly small grains. The most significant revision was in the livestock enterprise. These cash grain farmers have virtually eliminated the production of livestock. Current information shows that these cash grain farms produce no hogs but do maintain a cow or two to produce milk for the operator's family and have a farm-size flock of chickens from which there is a small income from the sale of eggs. Farm investment was also revised. Investment in land and buildings was revised upward on the basis of better sources of average values of land per acre in this area. Machinery investment has been about doubled as the enumerative survey showed that these farms had more and newer equipment than had been previously estimated.

On the basis of an enumerative field survey made in February 1965 and data published by the South Dakota Crop and Livestock Reporting Service, revisions were made in the costs and returns series for typical or representative wheat-corn-livestock farms in the Northern Plains. Minor revisions beginning with 1959 were made in the estimates for this series to make them more representative of this type of farm in the Corn Belt fringe areas of northeastern South Dakota and southeastern North Dakota. The total average size of farm remained unchanged, but minor changes were made in the acreage harvested, crop yields, livestock numbers, feed purchases, and expenditures for machinery and equipment.

In cooperation with the Kentucky and Tennessee Experiment Stations, work was continued toward developing cost and return series for 2 types of farms in the Pennyroyal Area. Estimates of income and expenses, farm organization, land use, investment, input-output relationships, and related factors for the years 1954-1965 neared completion.

Work also continued on the costs and returns series for cattle ranches in the Northern Rocky Mountain area of southwestern Montana and east central Idaho. Ranch size, livestock numbers and systems, land use, and gross ranch income for the years 1955-1965 neared completion.

Questionnaires from the National Pesticide Survey for counties in the Kentucky Bluegrass area, Coastal Plain of North Carolina, and the Kentucky-Tennessee Pennyroyal area were tabulated and summarized and the results used to supplement data from other sources in making estimates of kinds, quantities, prices and expenditures for pesticides on the representative or typical farms in the costs and returns series. Information on pesticides in the past has indicated that many types and varieties of pesticides have and are being used, but data, at best, have been sparse and meager except for special field enumerative surveys in the costs and returns work. These tabulations from the pesticide survey provided comprehensive data on kinds of materials used, rates of application, and costs of materials and application.

Enumerative field surveys were also made on dairy-hog farms in southeastern Minnesota, Grade B dairy farms in western Wisconsin, wheat-small

grain-livestock farms in the Northern Plains, winter wheat farms in the Southern Plains, tobacco-livestock farms in the Inner Bluegrass area of Kentucky, and tobacco-dairy farms in the Intermediate area and the Outer Bluegrass area of Kentucky. Data from these surveys were used to revise the basic organization of these farms and to update information on land use, crop and livestock practices, and technological changes and machinery inventories and farm expenses.

In 1965 net farm incomes averaged higher than in 1964 on 31 of 42 important types of farms, were lower than in 1964 on 9 types of farms, and were about the same in both years on 2 types. Increases in net farm income ranged from 1 percent to 425 percent while declines varied from 4 percent to 24 percent. Both the largest increase in returns and the largest decline occurred on cotton farms. Net farm income per farm on nonirrigated cotton farms in the High Plains of Texas advanced from \$1,877 in 1964, a year of extreme drought in this area, to \$9,857 in 1965. On large cotton-general crop farms in the San Joaquin Valley of California, net farm income declined from \$100,141 in 1964 to \$75,920 in 1965.

Increases in income from 1964 to 1965 were often substantial. Of the 31 farm types with higher incomes in 1965, more than half showed increases of 25 percent or more. Only 3 of the 31 farm types showed gains of less than 10 percent. On the other hand, only 2 of the 9 farm types with lower incomes in 1965 showed declines of more than 20 percent.

The major factors contributing to higher incomes in 1965 were increases in farm production and in prices received for farm products sold. All of the farm types that had higher incomes in 1965, except wheat-fallow farms in the Pacific Northwest, showed increases either in net farm production or in prices received, or both.

Net farm production was lower in 1965 than in 1964 on all 9 types of farms on which incomes declined. On 5 of these 9 farm types lower production was combined with lower prices received for products sold. These 5 were: Cotton farms in the Southern Piedmont, small and large-scale cotton farms in the Mississippi Delta, and the medium and large cotton-general crop farms in the San Joaquin Valley of California.

The largest declines in production in 1965 occurred on tobacco and tobacco-cotton farms in the Coastal Plain of North Carolina. On these farms the acreage planted in tobacco was substantially below that of a year earlier.

Prices received advanced strongly in 1965 on farm types with major livestock enterprises, particularly on those where hogs, feeder calves, and lambs were important. Prices received averaged substantially higher than in 1964 on cotton-specialty crop farms in the San Joaquin Valley of California. Potatoes are an important crop on these farms and potato prices were up 32 percent in 1965.

Prices paid for goods and services used in production averaged higher in 1965 than a year earlier on 34 of the 42 types of farms. They declined on 7 types and were virtually unchanged on 1 type. Prices paid averaged higher in 1965 on all 9 of the farm types where incomes declined.

In 1965 operating expenses advanced from those of the previous year on 33 of the 42 types of farms. Expenses declined on 6 and were not significantly different in the 2 years on 3 types of farms. Operating expenses respond to changes in quantities of inputs used as well as to changes in prices paid for inputs. Expenses advanced in 1965 on 4 of 7 farm types where prices paid averaged lower than in 1964. Operating expenses on these 4 types averaged from 7 to 19 percent above 1964 levels. However, net farm incomes ranged from 19 to 76 percent above those of 1964.

Although operating expenses were higher in 1965 on most of the farm types, increases in production and in prices received for products sold on many farms offset the higher costs. For example, of the 33 types of farms with higher expenses in 1965, 25 also had higher incomes. On 19 of these farms, operating expenses per unit of production declined from 1 to 80 percent and on about half of these the decline was greater than 10 percent.

The annual outlook issue of the Farm Cost Situation was published in November 1965, summarizing significant developments and outlook implications in the use and cost of the major farm production inputs. It also contained a summary of costs and returns on 8 types of farms selected to represent the major types in the United States. This issue indicated a further rise in farm production expenses for 1966, including increases in expenses for fertilizer, pesticides, interest, taxes, insurance, and depreciation of capital items.



PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Costs and Returns by Major Types of Farms

Economic Research Service. 1965. The farm cost situation. 1966 Outlook issue. FCS-37, pp. 37-46.

Goodsell, W. D. and Gray, J. R. 1966. Costs and returns, western livestock ranches, 1965. FCR-37. 13 pp.

Goodsell, W. D. and others. 1966. Farm costs and returns, commercial farms, by type, size, and location. AIB-230 (Revised Aug. 1966). 99 pp.

Hole, E. 1966. Costs and returns, commercial dairy farms, Northeast and Midwest, 1965. FCR-43. 9 pp.

Hurd, E. B. 1966. Costs and returns, commercial wheat farms, Pacific Northwest, Northern Plains, and Southern Plains, 1965. FCR-39. 16 pp.

Mateyka, D. T. and Reed, F. D. 1966. Costs and returns, commercial broiler farms, Maine, Delmarva, and Georgia, 1965. FCR-38. 18 pp.

Mateyka, D. T. and Latimer, R. G. 1966. Costs and returns, commercial egg-producing farms, New Jersey, 1965. FCR-41. 8 pp.

Rosenberry, P. E. 1966. Costs and returns, commercial Corn Belt farms, 1965. FCR-42. 10 pp.

Shugars, O. K. 1966. Costs and returns, commercial tobacco farms, Coastal Plain, North Carolina, 1965. FCR-36. 9 pp.

Shugars, O. K. and Bondurant, J. H. 1966. Costs and returns, commercial tobacco-livestock farms, Bluegrass area, Kentucky, 1965. FCR-40. 13 pp.

Strand, E. G. 1966. Costs and returns, commercial cotton farms. FCR-44. 13 pp.

RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

Blakley, Leo V., Walker, Odell L., and McNeeley, John G., Jr. 1965. Monthly variations of beef cattle prices in Oklahoma. Okla. Agr. Expt. Sta. Bul. B-642.

Missouri Agricultural Experiment Station. Beef cows - feed consumption and cost. Sta. Bul. 825.

Missouri Agricultural Experiment Station. Labor requirements of beef cows. Sta. Bul. 838.

## AREA NO. 9. FARM LABOR UTILIZATION AND PRODUCTIVITY

Problem. The utilization of human effort in farm production has changed greatly in recent decades and will likely change even more rapidly in the years to come. Technological and other economic developments increase the productivity of individual workers and make possible a decrease in the number of persons engaged in farmwork. But these developments require higher levels of skill and knowledge on the part of the persons continuing to do farmwork, while forcing other workers to seek nonfarm employment. At the same time, the increasing attractiveness of nonfarm jobs together with various social and economic changes exert upward pressures on earnings and perquisites in many types of farm employment. Because of the many economic, social, and other changes that affect the utilization of human effort in farm production, a better understanding of these changes is needed to assist in planning for and guiding the human and economic adjustments involved.

### USDA AND COOPERATIVE PROGRAM

Work on farm labor requirements and use is carried on as a continuing program in Washington, D. C. This work is aimed at keeping abreast of farm labor used, nationally and by regions, in total and by major enterprises. Estimates of man-hours of farmwork are prepared annually, based on pertinent secondary data and, when necessary, by field surveys. This series of estimates, going back to 1910, gives a comprehensive statistical picture of what has happened to farm labor requirements over the years.

A continuing program of farm labor productivity and efficiency is conducted in Washington, D. C. It provides annual indexes of farm production per man-hour, with breakdowns by regions and by major commodities. The series of estimates provides comprehensive measures of farm labor productivity over the years. Periodically, analyses are made of the past and projected future effects of technological and other developments on production per man-hour and on quantity of labor input used.

In a continuing program, studies are made of the effects of rising labor costs on demand for labor, farm production, adoption of new technology, and on the changing structure of agriculture. Unit farm labor costs are increasing rapidly because of a number of different factors including such Federal legislation as a minimum wage and Social Security, and in some States by such legislation as workmen's compensation, unemployment insurance, and make-up pay. Also, increased competition for workers by the nonfarm sector as the economy operates at nearly full employment, rising skill levels needed by farmworkers to operate more complex labor-saving equipment, higher perquisites and incentive payments, and attempts to reduce seasonal employment to provide more continuous work periods have been major contributors to rising unit farm labor costs. Current research



is located at Washington, D. C. and includes nationwide surveys of labor and related data by such farm characteristics as type, size, and economic class.

Cooperative work was carried on with the Maine, Michigan, Purdue, Washington, Oregon, and California Experiment Stations.

A total of 4.0 Federal scientific man-years is devoted to this research area, distributed as follows: Farm labor requirements and use, 0.8 man-years; farm labor productivity and efficiency, 0.2 man-years; economics of farm labor utilization, 2.8 man-years; and economic relationships between farm operators and hired farmworkers, 0.2 man-years.

#### PROGRAM OF STATE EXPERIMENT STATIONS

A total of 8.3 scientist man-years is devoted to this area of research.

#### PROGRESS -- USDA AND COOPERATIVE PROGRAM

##### A. Farm Labor Requirements and Use

The continuing research on labor requirements and use in farm production indicated that labor used on U. S. farms in 1965 reached a new low of about 8 billion man-hours, 5 percent less than in 1964. Labor devoted to care of livestock dropped more than for all crops, but requirements for cotton and tobacco dropped sharply. Additional mechanization largely accounts for the decrease in labor for cotton (85 percent was machine harvested in 1965, compared with 78 percent in 1964) while the reduction for tobacco resulted from fewer acres and lower yields per acre.

Farmwork required fewer man-hours in 1965 than in 1964 in all parts of the country. The decrease was 9 percent in both the Appalachian and Delta States, reflecting chiefly the decline in labor requirements for tobacco and cotton. In the other regions, the drop in man-hours was more moderate, ranging down to only 2 percent in the Southern Plains and Mountain regions.

##### B. Farm Labor Productivity and Efficiency

The continuing research on farm labor productivity and efficiency shows that farm output per man-hour rose almost 8 percent from 1964 to 1965, to 153 percent of the 1957-59 average. The increase for crops as a whole was 2.7 times the gain for livestock. Production per man-hour of 2 important groups of crops, feed grains and cotton, rose 21 and 16 percent, respectively, from 1964 to 1965. These large gains contributed significantly to the 13-percent increase for all crops. Since 1957-59, the greatest gain in farm output per man-hour has occurred in the Delta States. In 1965 in this area, it was 190 percent of the 1957-59 average. In the Pacific region where fruits and vegetables are important, the increase in labor productivity has been smallest because these crops are difficult to mechanize.



There were 5.6 million farmworkers in 1965, and each, on the average, produced enough food, fiber, and other farm products to supply himself and 36 other consumers. This is a greater increase in the farmworker-consumer ratio than has occurred for any previous year. Most of the consumers were U. S. residents, but in 1965 about 17 percent were the citizens of foreign countries who were supplied through exports from the United States. The gain in persons supplied per farmworker has resulted from greater application of modern technology both on and off the farm, including the transfer of jobs from farm to nonfarmworkers.

### C. Economics of Farm Labor Utilization

A project, cooperative with the California Experiment Station, on labor and capital in selected crops and areas in California was concluded. Two principal areas were studied - Kern County, an area where crop production has become highly mechanized, and Stanislaus County, an area growing labor-intensive crops having highly seasonal labor demands. The Kern County phase of the study was completed prior to the reporting year. The Stanislaus County phase was completed during the year and a report was released. A third phase, which compared the employment, wages, and working conditions of hired farmworkers in a highly mechanized area versus one where hand labor predominated, was completed during the year. Significant differences exist in the labor forces in the 2 areas. Kern County had twice the proportion of general farmworkers than did Stanislaus. The proportion who did no migrating was also twice as large in Kern County. Kern County hired workers had a 9-percent longer farmwork year and earned 16 percent more income from farming than did workers in Stanislaus County. Information on days worked, tasks, earnings, migration, and other pertinent characteristics by different worker classifications are presented in a report to be published by the California Experiment Station and the Economic Research Service.

A study of the economic impacts of a changing labor force in Aroostook County, Maine, is underway in cooperation with the Maine Agricultural Experiment Station. Data, primarily from secondary sources and other research studies, are being assembled on various facets of farming operations in Aroostook County. Illustrative of this is the information that has been assembled and partially analyzed relating to employment of Canadians in the potato harvest. Within the last decade, trends have changed as there was an expansion in numbers early in the period followed by declines to the present authorization of 3,000 workers for the 1966 harvest. The potential for mechanization differs from one area to another and is directly dependent upon soil resources.

Analyses are underway to determine if there is a place for sugarbeet production on central Maine dairy farms as well as on Aroostook County potato farms. Results indicate that under a broad price interval for milk, beets can effectively compete with resources on typical dairy farms. However, land which is suitable for sugarbeet production is also suitable for corn, clover and alfalfa production. This land is in short supply on the typical

dairy farm, and is an important factor in limiting the potential production of sugarbeets.

In cooperation with Michigan Experiment Station, a project to study the demand for labor on Michigan fruit farms has been initiated. This study will evaluate response to rising labor costs on adoption of production technology, economic structure of the industry, size and number of farms, and changes in the processing industry.

The economic impact of labor-saving technology and a diminishing supply of farm labor upon the agricultural economy on the Sacramento, California, canning tomato area is the subject of a study initiated in cooperation with the California Experiment Station. From 1963 to 1966, the California canning tomato crop rose from less than one percent to 75 percent mechanically harvested. Growers have invested in some 800 machines to replace the Braceros. This study will analyze effects of this capital-labor substitution.

A study of factors affecting the current and prospective demand for hired farm labor in the State of Washington has been initiated, in cooperation with the Washington Experiment Station.

A project was initiated in cooperation with Purdue to analyze the impact of technological change on the demand for and use of farm labor with special references on factor returns and the labor skills needed in farming.

Considerable material was prepared for a chapter, "Farmworkers," for the 1966 Manpower Report of the President, and for a "comprehensive study of the entire agricultural labor situation" requested by the Congress. This latter report has the tentative title "Farm Labor in a Changing Agriculture." These reports show that in 1965, farm operators and unpaid family workers averaged 4.1 million or almost 3/4 of the total of 5.6 million workers employed on farms. The other 1.5 million were hired. Since 1950, farmworkers have decreased almost 45 percent, with a greater drop in family workers. This means that hired workers now constitute a greater proportion of the total than formerly. The overall drop and the differential rate of decrease for different classes of workers are related to many changes in farming such as the decrease in farms and their consolidation into larger units, the great advances in farm mechanization, and the transfer of jobs to nonfarm business firms. If the 12.1 million workers employed in farm-related businesses are added to farmworkers, the total constitutes about 1/4 of total civilian employment.

Farmwork is highly seasonal and more members of the farm family help during busy seasons but most of the additional workers required in peak work periods are hired. Thus, the month-to-month variation in employment is greater for hired workers than for family workers. Not only is the seasonal variation in employment of family workers relatively low but it decreased during the last decade in most parts of the country. On the other



hand, the seasonal variation in employment of hired workers rose somewhat nationally, but there were great and almost offsetting changes among regions.

On farms, cash wage rates per hour without board or room averaged \$1.14 in 1965. This is lower than those paid in the nonfarm sectors of the economy. Hourly earnings of production workers in manufacturing, for example, averaged \$2.61. Many factors account for these differences. Farm products, generally, are in abundant supply, the demand for farm labor is trending downward, and the supply of labor is overabundant for many crops and in some areas. The supply of workers for some nonfarm occupations is in effect largely controlled while for others, including farms, it is largely unregulated. Other reasons include differences in level of productivity, education and skill required for the jobs, extent of unionization, and the relative bargaining positions.

Wide differences in farm wage rates exist among States and regions. In 1965, workers paid by the hour without board or room received less than \$1.00 per hour in 13 States, all in the Southeastern part of the country. Rates ranged from \$1.00 to \$1.14 per hour in 4 States and from \$1.15 to \$1.29 in 21 States. The latter forms a belt from northern New England to the 3 northeast Mountain States. Cash hourly rates averaged \$1.30 or more in 10 States, 4 of which were in the Northeast and the other 6 in the western part of the country.

Projections of farm employment made as part of this work indicate that farm operators and unpaid family workers will decline to an annual average of about 2.6 million in 1980 compared with 4.1 million in 1965. Hired workers would average about 1 million or a reduction of about 1/3 of the 1965 average. These projections are based partly on the projections of farm production made by the ERS Committee on Economic Projections and on projections of production per man-hour. The projected indexes of production and of production per man-hour are divided to yield projected indexes of labor input. A major advantage of projecting production per unit of labor is that it reflects the net effect of all factors affecting farm production or labor input. If the projections materialize, man-hours of farmwork would total about 5.5 billion in 1980 compared with about 8 billion in 1965. Growing and harvesting crops would take 2.5 billion man-hours in 1980, and care of livestock 2.2 billion. Crops and livestock required about 3.8 and 3.1 billion man-hours, respectively, in 1965.

During the legislative process, a number of administrative documents were prepared, at the request of the Office of the Secretary and the Department of Labor, evaluating the impact of extending a Federal minimum wage to hired farmworkers under H. R. 13712. This Bill, which was enacted into law Sept. 23, 1966, amends the Fair Labor Standards Act of 1938, as amended, to extend coverage to about 390,000 hired farmworkers. It covers workers on farms hiring 500 or more man-days of labor in a peak calendar quarter of the previous year. The legislation becomes effective in February 1967, and will cover an estimated 33,000 commercial farms. Estimates were



prepared on the number of farms covered by type and farm production region. The greatest number of farms covered will be cotton farms -- nearly 3/10 of the total. Other types that will be materially affected are fruit, cash grain, dairy, and vegetable farms. In range production of livestock, shepherds and cowboys whose principal work is caring for livestock on range will be excluded from minimum wage coverage even on farms hiring 500 or more man-days of labor in a quarter.

Nearly half of the workers that will be newly covered under the Act work in the South. Of these, about 2/5 are currently paid less than \$1.00 per hour. Beginning in February 1967, the Federal minimum rate for hired farmworkers will be \$1.00 per hour and it will advance to \$1.15 and \$1.30 per hour in February 1968 and February 1969, respectively. The proportion of newly covered workers not earning \$1.00 or more per hour ranges from 3 to 30 percent in regions outside the South.

D. Economic Relationships Between Farm Operators and Hired Farmworkers

A study has been completed on the feasibility of alternative methods of providing housing for migrant farmworkers in Oregon. The results, which were summarized in last year's report, are in press as Oregon Statistical Bulletin 602 "A Survey of Migrant Farmworkers' Housing in Oregon" by M. J. Corklin and R. C. McElroy.

PUBLICATIONS -- USDA AND COOPERATIVE PROGRAM

A. Farm Labor Requirements and Use

Farm Production Economics Division. 1966. Man-hours of labor used for farmwork, by groups of livestock and crops, for each farm production region, 1939-65. USDA Stat. Bul. 233. Sup. III. 12 pp.

B. Farm Labor Productivity and Efficiency

Farm Production Economics Division. 1966. Changes in farm production and efficiency. USDA Stat. Bul. 233 revised. 36 pp.

Farm Production Economics Division. 1966. Index numbers of farm production per man-hour, by groups of livestock and crops, for each farm production region, 1939-65. USDA Stat. Bul. 233. Sup. IV. 12 pp.

C. Economics of Farm Labor Utilization

Metzler, W. H. 1966. Farmworkers in a specialized season crop area - Stanislaus County, California. Giannini Foundation Res. Rpt. 289. 90 pp.

D. Economic Relationships Between Farm Operators and Hired Farmworkers

None.

RELATED PUBLICATIONS OF STATE EXPERIMENT STATIONS

None reported.

## Line Project Check List -- Reporting Year Sept. 1, 1965 to Oct. 1, 1966

Work and Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Proj. Incl. in	
			Summary of Progress	Area and Subheading
FE 1 FE 1-10	Farm capital, credit, and financial condition Financial management of farm firms	Washington, D.C., East Lansing, Mich., Urbana, Ill., Carbondale, Ill., Gainesville, Fla., & Lafayette, Ind.	Yes	4-C
FE 1-11	Maintenance and improvement of farm credit statistics and analysis of trends	Washington, D.C.	Yes	4-B&C
FE 1-12 (Super-sedes FE 1-4 & FE 1-5)	The changing farm financial condition and its relation to the structure of agriculture	Washington, D.C., & East Lansing, Mich.	Yes	4-A
FE 1-13 (Super-sedes FE 1-3 & FE 1-7)	Factors affecting cost, terms, availability and condition of credit and capital for farmers and rural areas	Washington, D.C., & Columbia, Mo.	Yes	4-B
FE 2 FE 2-1 (Rev.)	Farmland values and valuation Current developments in the farm real estate situation	Washington, D.C.	Yes	6-A&B
FE 2-2 (Rev.)	Annual estimates and analysis of trends in farm real estate rentals	Washington, D.C.	Yes	6-C
FE 3 FE 3-4	Agricultural risks and insurance Risk and risk-bearing in selected agricultural areas	Washington, D.C., Bozeman, Mont., Manhattan, Kans., & University Park, Pa.	Yes	5-D
FE 3-5	Measurement and analysis of farm losses and farm insurance	Washington, D.C.	Yes	5-A, B&C
FE 0-0-1 (FCIC)	Economic impacts of Federal crop insurance**	Washington, D.C. & Bozeman, Mont.	No	---
FE 9 FE 9-1	Agricultural adjustments and production response Economic evaluation of forage production and utilization in New Hampshire**	Durham, N. H.	No	---
FE 9-2 (Rev.)	A study of farm organization and management problems in southeastern and southwestern Minnesota	St. Paul, Minn.	Yes	2-A
FE 9-4	An economic evaluation of changes in use of farmlands within Wisconsin watershed projects**	Madison, Wis.	No	---
FE 9-5 (Rev.)	Economics of adjustments in beef production in the west	Tucson, Ariz., Ft. Collins, Colo., & Lincoln, Nebr.	Yes	1-G
FE 9-7 (Rev.)	Economics of adjustments in cotton producing areas in California	Davis, Calif.	Yes	1-D
FE 9-8	Adjustments in the economy of the Belle Fourche area and analysis of Newell Field Station experiments**	Brookings, S. Dak.	Yes	1-G
FE 9-9 (Rev.)	An economic appraisal of adjustment opportunities in southern rice producing areas	Fayetteville, Ark., Baton Rouge, La., & College Station, Tex.	Yes	1-F

\* Initiated during reporting year. \*\* Discontinued during reporting year.



-76-  
Line Project Check List -- Reporting Year Sept. 1, 1965 to Oct. 1, 1966

Work and Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Proj. Incl. in	
			Summary of Progress	Area and Subheading
FE 9-11	Adjustments in hog and beef cattle production in the Corn Belt to meet changing conditions -- FE cooperation in Regional Project NC-54	Washington, D.C., & selected States	Yes	1-G
FE 9-14	Economic appraisal of adjustments in Corn Belt farming to meet changing conditions	Washington, D.C., & selected States	Yes	1-G
FE 9-15	Economic appraisal of adjustments in dairy farming in the Lake States and adjoining areas to meet changing conditions	Washington, D.C., & selected States	Yes	1-C
FE 9-16	Economic appraisal of adjustments in dairy farming in the Northeast to meet changing conditions	Washington, D.C., & selected States	Yes	1-C
FE 9-17	Economics of adjustments on farms and production response in the Northern Plains wheat producing region	Washington, D.C., & selected States	Yes	1-E
FE 9-18	Production economics studies of agricultural production control programs	Washington, D.C., & selected States	Yes	1-H
FE 9-19	Analysis of agricultural production response	Washington, D.C., & selected States	Yes	1-B
FE 9-20	Economic appraisals of emerging technological developments in southern agriculture	Washington, D.C., & selected States	Yes	2-A&B
FE 9-21	An economic appraisal of emerging crop, livestock, and poultry technologies in the northern region	Washington, D.C., & selected States	Yes	2-A
FE 9-22	An economic appraisal of farming adjustment opportunities in the southeastern region to meet changing conditions	Washington, D.C., & selected States	Yes	1-D
FE 9-23	Economics of adjustments on farms and production response in the Southern Plains wheat producing region	Washington, D.C., & selected States	Yes	1-E
FE 9-24	Economics of adjustments on farms and production response in the Pacific Northwest wheat producing region	Washington, D.C., & selected States	Yes	1-E
FE 9-25	Farm management under conditions of variable output in the Great Plains	Bozeman, Mont.	No	---
FE 9-26	An economic appraisal of business survival probabilities of farms and ranches in the Great Plains area of Oklahoma**	Stillwater, Okla.	Yes	2-A
FE 9-27	An economic appraisal of farming adjustment opportunities in the South Central region to meet changing conditions	Washington, D.C., & selected States	Yes	2-A&B
FE 9-28	Economic appraisal of regional adjustments in agricultural production and resource use to meet changing demand and technology	Ames, Iowa	Yes	1-B
FE 9-30	Economic analysis of production problems and adjustments on western range-livestock ranches	Washington, D.C., & selected States	Yes	1-G
FE 9-31	Appraisal of year-to-year changes in the cost of producing cotton in the U. S.	Washington, D.C., & selected States	Yes	1-I
FE 10 FE 10-1 (Rev.)	Economics of farm size Economic appraisal of minimum farm resources needed for specified farm income levels**	Washington, D.C., & selected States	Yes	3-B

\* Initiated during reporting year. \*\* Discontinued during reporting year.

## Line Project Check List -- Reporting Year Sept. 1, 1965 to Oct. 1, 1966

Work and Line Project Number	Work and Line Project Titles	Work Locations During Past Year	Line Proj. Incl. in	
			Summary of Progress	Area and Subheading
FE 10-2 (Rev.)	Classification and analysis of kinds and sizes of farms	Washington, D.C.	Yes	3-B
FE 10-4	Optimum and feasible adjustments in size and number of farms in selected areas	Washington, D.C., & selected States	Yes	3-B
FE P-1	Pioneering research in vertical coordination**	Washington, D.C.	No	---
FE-ME 1	Changing structure and performance of the American agricultural chemical industry and its coordination with farms	Washington, D.C.	Yes	3-A
FE 11	Economics of farm labor resources and utilization			
FE 11-1	Maintenance and improvement of annual estimates of labor requirements in American agriculture	Washington, D.C.	Yes	9-A
FE 11-2	Measurement and analysis of labor productivity and efficiency in American agriculture	Washington, D.C.	Yes	9-B
FE 11-3	Labor and capital in selected crops and areas in California**	Washington, D.C., & Davis, Calif.	Yes	9-C
FE 11-5	Economic and related aspects of providing housing for migrant hired farmworkers**	Washington, D.C., & Corvallis, Oreg.	No	---
FE 12	Economics of technological changes in farming			
FE 12-1 (Rev.)	Measurement and analysis of progress in farm mechanization	Washington, D.C.	No	---
FE 12-2 (Rev.)	National survey and analysis of selected farm production practices	Washington, D.C.	Yes	8-D
FE 12-3 (Rev.)	Annual estimates of feed consumption and animal units in the U. S. by class and species of livestock	Washington, D.C.	Yes	8-B
FE 12-6	Economic interpretation of yield response to fertilizer and associated technology	Washington, D.C.	Yes	8-E
FE 12-7 (C)	The farm demand for fertilizer, machinery, and structures	Washington, D.C., Ames, Iowa, & East Lansing, Mich.	Yes	8-F
FE 12-9	Economic evaluation of pasture production	Washington, D.C.	No	---
FE 12-10	Economics of pesticide use in agriculture	Washington, D.C., Lincoln, Nebr., & East Lansing, Mich.	Yes	8-A
FE 12-11	Estimates of principal plant nutrients used on specified crops - 1964	Washington, D.C.	Yes	8-D
FE 12-12	Economic impact of structural changes in the livestock-feed industry*	Washington, D.C.	Yes	8-B
FE 13	Farm output and resource productivity			
FE 13-3	Appraisal of the influence of weather on crop yields and production	Washington, D.C.	Yes	1-A
FE 13-4	Appraisal of farm production prospects and resource needs	Washington, D.C.	Yes	1-A
FE 13-5 (Super-sedes FE 13-1 & FE 13-2)	Measurement and analyses of farm output and resources used	Washington, D.C., & Stillwater, Okla.	Yes	1-A
FE 14	Farm costs and returns			
FE 14-1 (Rev.)	Annual estimates and analyses of changes in costs, returns, and farm organization on commercial family-operated farms by type and size	Washington, D.C.	Yes	8-A
FE 14-2	Preparation of "Farm Cost Situation" reports	Washington, D.C.	Yes	8-A
FE 14-3 (Rev.)	Costs and returns on commercial poultry farms (egg and broiler) in the Northeastern, Middle Atlantic, and Southeastern States	Washington, D.C.	Yes	8-A

\* Initiated during reporting year. \*\* Discontinued during reporting year.

